ECONOMETRIC MODELS OF U. S. NAVY CAREER PETTY OFFICER RETENTION

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THESIS

ECONOMETRIC MODELS OF U. S. NAVY CAREER
PETTY OFFICER RETENTION

by

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June 1981

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The main conclusions of the study are:

a. Economic variables such as military compensation, unemployment, and

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civilian wage opportunities are statistically significant predictors of career petty officer retention behavior.

b. All-navy reenlistment rate can very accurately be predicted using a regression model with economic variables when the independent variables are within the range of values used to generate the regression model.

c. Such regression models generally have very low predictive ability when derived from and applied to petty officers grouped into occupational fields.

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Econometric Models of U. S. Navy Career Petty Officer Retention

by

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ABSTRACT

This thesis investigates the reenlistment behavior of U. S. Naval personnel who have completed more than two enlistment terms in the Navy. The Navy's 110 ratings are grouped into 24 occupational fields which represent clusters of similar skills, similar working conditions, and similar duty assignments. Multiple regression techniques are used to examine the relationship of economic variables to career reenlistment behavior.

The main conclusions of the study are:

a. Economic variables such as military compensation, unemployment, and civilian wage opportunities are statistically significant predictors of career petty officer retention behavior.

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I. INTRODUCTION

Most of the published research concerning the retention of military personnel has focused on the initial term of active obligated service. This thesis addresses a different but very important segment of military manpower, the careerist. Specifically, it investigates the retention behavior of career petty officers in the U. S. Navy.

For most non-rated navy members and junior petty officers, much of the first term is spent in formal schools and intensive on-the-job training. Using a human capital approach, these servicemembers are receiving a "loan" from the navy which has the expectation that their post-school productivity will "pay back" the "loan." Since World War II, and especially since the early 1960's, the amount of training required to operate and maintain the sophisticated equipment has increased the length and cost of the loan period. It may be questioned whether the enlistee can be productive enough in a four year period to pay back the navy. The navy is therefore faced with two options: to increase the length of the initial enlistment, or to increase the reenlistment rate for first, second, third, and subsequent reenlistments.

The extension of the initial enlistment to six years has been done for some ratings that require over 12 months of initial formal schooling. The second option, however, is the one that is the most promising since it seeks to encourage personnel to remain voluntarily on active duty. By increasing the inducements for reenlistments, the

Navy will have a wider selection for the more senior grades and can select only the best qualified persons to manage and lead the enlisted force. The retention rate for personnel who have reenlisted at least once decreased rather steadily during the period 1976 to 1980. Although the downward trend suddenly stopped in the 4th quarter of FY 1980, and is now on the rise, it should not be assumed that a problem of retaining experienced petty officers will not return.

This thesis is an investigation into the reenlistment behavior of those personnel who have reenlisted at least once before. The Navy's 110 ratings are grouped into 24 occupational fields which represent clusters of similar skills, similar working conditions, and similar duty assignments. Several models which have been published by other researchers are analyzed using occupational field data. It is the goal of this thesis to develop forecast models to predict occupational specific retention rates. New models are developed using career reenlistment data and economic variables from the period FY 1976 to FY 1980. All models are subjected to tests of validity and forecasting value.

If significant differences exist among occupational fields in reenlistment rates or predictors of those rates, it may be to the Navy's advantage to investigate further occupational field or rating specific manpower policies and offer selective inducements for career reenlistments as is currently done with the first term reenlistment bonus. The career reenlistment bonus program, which is still new compared to the first term bonus program, may need to be modified to be more sensitive to the actual determinants of career reenlistments.

Chapter II presents a review of previous reenlistment studies. The first section presents models that emphasize service policy variables. The second section presents models that emphasize civilian economic variables.

Chapter III presents the methodology used in developing the variables for use in linear regression analysis. There are basically four categories of variables used in this thesis: military compensation; male 25-39 year old unemployment rates; measures of civilian economic conditions including earnings; and military/civilian wage ratios.

Chapter IV presents and discusses the results of single and multiple linear regression equations.

Chapter V presents the conclusions of the study and the implications for navy manpower policy and future research.

II. REVIEW OF SELECTED PUBLISHED STUDIES ON MILITARY PERSONNEL SUPPLY

This chapter presents a review of previous reenlistment studies. The first section presents models that emphasize service policy variables. The second section presents models that emphasize civilian economic variables.

A. RETENTION DETERMINED BY SERVICE POLICY VARIABLES

1. Training Cost and the Draft

Drexler, in 1975 [Ref. 1], conducted a study which related costs of training and reasons for enlistment under the draft to the first term reenlistment decision. He hypothesized that true volunteers had a different reenlistment behavior than draft motivated personnel. The cost of training factor was added to be able to predict the reenlistment of those personnel trained in more costly skills. Drexler used three classifications for reason of enlistment: draft motivated persons, choice motivated persons, and true volunteers. Draft motivated persons were those who anticipated being conscripted, and therefore enlisted in the Navy as an escape from the Army. Choice motivated persons also enlisted to avoid the draft, but specifically chose the Navy over other services. True volunteers did not face conscription, but enlisted in the Navy anyway. Training costs for ratings were taken from Bureau of Naval Personnel records. Data for the study were collected by a survey of 2522 first term personnel. The sample was stratified for rating, fleet distribution, ship type, and shore station type.

The results of the survey show that the largest proportion of those who showed an intention to reenlist came from the true volunteer classification (29 percent). This was followed by choice motivated persons (19 percent) and draft avoiders (7 percent). When training costs were considered, 40 percent of the true volunteers who received expensive training (N=75) intended to reenlist. In general, the largest proportion of persons intending to reenlist were in the expensive training category (25% out of N=209).

Drexler also tried to determine the best predictors of first term reenlistment intention in each combination of training cost and method of entry classification. Individual navy experience factors were used as independent variables separated into three categories: facets of organizational climate, facets of supervisor interaction, and the relationship with peers. The results of linear regression analysis showed that little variance in the reenlistment intention of draft avoiders could be explained by the in-service experience variables. For true volunteers, on the other hand, in-service experience variables accounted for 60 percent of the variance in their reenlistment intentions.

Drexler concluded that the threat of the draft did make a difference in the attitude of enlistees and that this effect showed up at the first reenlistment point.

2. Training Costs and the Reenlistment Bonus

The relationship between training costs and first term reenlistment was also analyzed in a study by Stewart in 1976 [Ref. 2]. Stewart hypothesized that the type of occupational skill acquired, which could

be costed, played a significant role in the decision to reenlist at the end of the initial period of service. His data were from all-navy first term reenlistment statistics in 1972. He reasoned that those who had undergone more costly training have probably acquired a higher skill and are more likely to be motivated to a career in the military than those who receive less technical, less costly skill training. Measuring training cost by the number of Naval Enlisted Classification (NEC) codes a person had, and the length of training undergone, Stewart found that enlistees with two or more NEC's had a reenlistment rate of 31% while those with one or no NEC's had a reenlistment rate of 21%. Comparing the length of training for 31 ratings, Stewart found that those who underwent lengthly (costly) training were more likely to reenlist than those whose training was brief and cheap.

In addition to training costs, Stewart examined the effect of the first term reenlistment bonus on first term and career reenlistments. The variable reenlistment bonus (VRB) had a positive but not statistically significant effect on first term reenlistment when used in a linear regression model. He did find a statistically significant negative relation between second term reenlistment and the presence of a first term bonus. Stewart concluded that the lack of a second reenlistment bonus is significant and such a bonus would increase the retention of career petty officers.

A study specifically focusing on the effect on reenlistment rates of a reenlistment bonus was conducted by Kleinman and Shugart in 1974 [Ref. 3]. Data were gathered on first and second reenlistments for 37 navy ratings for the period 1966 to 1973. Linear and logit regression

models were used to estimate the effect on the first term reenlistment rate of the first term reenlistment bonus. To study the effect of VRB on later reenlistments, continuation rates from the sixth to eleventh year were used as a proxy for the second term reenlistment rate.

Two base periods were chosen for analysis, FY 1966 to FY 1971, and FY 1967 to FY 1972. The periods were chosen because all ratings in these periods had no reenlistment bonus at one time during the periods. The two base periods also contained persons who reenlisted without VRB in FY 1964 and FY 1965. These non-receivers' continuation rates were compared with reenlistees in the same ratings who received a first term bonus in FY 1966. Two main hypotheses were tested. First, that the first term reenlistment rate is significantly and positively correlated with the VRB. Second, that individuals induced to reenlist by a first term bonus are less likely to reenlist again than those who did not receive a first term bonus.

Between the period FY 1968-1973 and the base period FY 1966-1971, the continuation rate for those personnel who never received a VRB fell by 1-1/2 percentage points. The continuation rate for personnel who received VRB fell by only 1 percentage point. The continuation rate for those personnel who received VRB for an earlier reenlistment fell by 2 percentage points. Regression results of both the linear and logit models also showed a lack of a strong inverse relationship between VRB and continuation rates. Kleinman and Shugart concluded that individuals who are induced to reenlist by a VRB are as likely to continue past the second term reenlistment point as those who reenlisted with no VRB.

3. Military Pay and the Reenlistment Bonus

A study to examine the responsiveness of Navy reenlistments to the large military pay increase of November 1971 was conducted by Haber and Stewart in 1975 [Ref. 4]. Reenlistment rates for paygrades E-4 to E-9 in CY 1971 and CY 1972 were compared among four occupational groups: Craftsmen, Clerical, Service, and Miscellaneous. The study assumed the wages of civilians in comparable jobs did not change as drastically as military wages did and, in fact, remained static. VRB was taken into account by further segregating those ratings within each of the four occupational groups which received a first term reenlistment bonus.

First term reenlistment rates were found to be higher for the VRB receivers than for non-VRB receivers for all groups. The average reenlistment rates for 1971 were 20.4% for VRB ratings, 10.6% for non-VRB ratings. For 1972 the figures were 27.3% and 14.7%, respectively.

The elasticity of first term reenlistments with respect to military pay was calculated by dividing the percentage change in the reenlistment rate for each occupational group and paygrade by the percentage change in pay for the paygrade. The results showed that for non-VRB ratings the elasticity exceeded 3.00 in 7 of 12 cases. The average elasticity for non-VRB ratings across all groups was 2.38. For VRB receivers an elasticity of 3.00 occurred in 5 of 11 cases. In general, the pay elasticity tended to be smaller in the VRB ratings than in the non-VRB ratings.

Careerists were defined in the study as individuals who had reenlisted one or more times. Since VRB was offered only at the first

reenlistment, no distinction was made between VRB and non-VRB ratings. Again, comparing the four occupational groups during the periods CY 1971-72, the study showed that reenlistment rates increased uniformily with paygrade. Paygrade E-4 reenlistment rates averaged 55.9% and 61.0% for the periods while those of E-7/8/9's averaged 99.0% and 99.2%. In both years the E-4 Craftsmen showed the lowest reenlistment rates with 52.6% in 1971 and 57.5% in 1972. Haber and Stewart concluded that since careerists had a much higher reenlistment rate than first termers, factors other than pay probably played an important role in their reenlistment decision. One such factor which they felt was the most important was the potential of receiving a pension after 20 years of service at age 39-41. No attempt was made to quantify the real or perceived present value of this pension in the study. Supporting their conclusion about the role of pensions was that careerist reenlistment rates were apparently only slightly affected by the November 1971 pay raise. The 1972 rates aggregated for all groups showed only a slight increase, from 89.4% to 90.8%. Predictably, the largest increase, from 55.9% to 61.0% occurred in the E-4's as their pay increased by a larger percent than did the senior groups.

A markedly different approach to analyzing the effect of military pay on reenlistments was undertaken by Massell in 1976 [Ref. 5]. Linear regression using military compensation as the sole independent variable gave the mean and standard deviation of the reservation wage. Military pay was defined as base pay, BAQ (with and without dependents sets were formed), subsistence allowance, federal tax advantage on non-taxable allowances, proficiency pay and VRB. The

sample was composed of white, male high school graduates less than 19-1/2 years old and who were in Air Force electronics specialties and who made their first reenlistment decisions in FY 1972.

The reservation wage is a hypothetical wage perceived by the person which can affect his reenlistment decision. If the reservation wage is greater than his military pay over the next enlistment period, he would not reenlist. If the reservation wage is less than his military pay over the next enlistment, he will reenlist. If it is equal, he is indifferent to reenlisting or leaving the military. In the last case the average reenlistment rate would be 50%. The concept of reservation wage is not unique to Massell's study. A more complete explanation can be found in Cooper [Ref. 6].

The mean and standard deviation of the reservation wage was mathematically derived by reasoning that the probability of separation is the same as the separation rate given a large sample size. The reenlistment rate is (1-separation rate). The separation rate is also equal to the probability that the reservation wage is greater than the perceived military wage.

Specifically:

$$\text{Prob}\ (R\ W) = \text{Prob}\ \frac{R - \mu}{\sigma} = Z > Y = \frac{W - \mu}{\sigma}$$

where formally;

R = Reservation wage

μ = Mean of R

σ = Standard deviation of R

Z = Standardized normal variable

W = Military compensation

Y = A value derived from the normal distribution table such that the probability that Z is greater than Y is equal to the separation rate (1 - reenlistment rate)

The mean and standard deviation were estimated by the linear model

$$Y = \alpha W + C$$

where formally:

Y = Reenlistment rate
α = Coefficient of military compensation variable
C = Constant derived from the linear regression equation

The parameters of the reservation wage are computed as follows:

$$\sigma = \frac{1}{\alpha}$$
$$\mu = -\sigma C$$

The models are intended to predict group rather than individual reenlistment behavior. Additionally, the most reliable results would be detained if the persons in the sample had similar characteristics, service experiences, and preceptions of the military. Massell termed these groups to be "homogeneous groups."

The sample was divided into six subgroups: Electronics Repairmen with and without dependents, Electronics Specialists with and without dependents, and the combined total with and without dependents.

The reservation wages developed from linear regression were larger than the military compensation amounts in every subgroup. Reservation wages were also larger than the means of civilian earnings reported on a post-service survey of the sample members who did separate during FY 1972. The R square varied from .38 to .89 with a mean of .75. Men with dependents were found to behave as though

having the dependents resulted in an increase to military compensation of about $15,000, regardless of the number of dependents. This was derived from their lower reservation wage and therefore higher reenlistment rate. Massell reasoned that what also may be affecting the reenlistment rate of men with dependents is the higher value they place on stability of employment than do single servicemen. Massell's finding here is consistent with a study by Grace [Ref. 7] on the effect of dependents on Navy reenlistment. Grace found by survey that 64.4% of the Navy wives questioned were willing for their husbands to reenlist. An even greater percent, 69.9%, would encourage their husbands to reenlist if the decision had to be made immediately.

B. RETENTION DETERMINED BY IN-SERVICE AND CIVILIAN ECONOMIC VARIABLES

1. Military Compensation, Civilian Opportunities and Personal Characteristics

Enns [Ref. 8] used FY 1971 reenlistment data for 1638 Navy, Air Force and Army servicemembers to identify predictors of the first term reenlistment rate. The independent variables for the Navy personnel were VRB, base pay, age at enlistment, AFQT score and education. The Army and Air Force data included estimated civilian earnings if the service member left the military at the end of the first term. The civilian earnings variable was recognized by Enns as being of questionable accuracy. It was constructed using mean hourly wage data reported by former service members about ten months after discharge. A 40 hour workweek and 50 work weeks per year were assumed. Civilian earnings data for Navy personnel were not available, consequently this variable

was not used in the Navy linear regression equations. Linear regression showed that for all models the VRB variable was positive and statistically significant at the .05 level. The coefficient of the earnings variable was negative and significant for the Army, but not significant for the Air Force. Education level was negative and significant for all three models while AFQT was negative for the Army and Navy, but not significant for the Air Force. Age at enlistment also showed variation between services. Enns concluded that no one model was valid for all three services and that individual service characteristics play an important role in accounting for first term reenlistment rates.

Enns computed the elasticity of first term reenlistment with respect to VRB. The elasticities for both the Air Force (3.4) and the Navy (2.5) were greater than the military pay-first term reenlistment elasticities reported by the Gates Commission: 2.4 and 2.1 for the Air Force and Navy, respectively. The Army elasticity of 2.1 was lower than the Gates Commission estimate of 2.4. Enns found that the reenlistment elasticity was greater for the cohort receiving their VRB in a lump sum as opposed to installment payments. He concluded, as had Kleinman and Shugart, that VRB has a positive and significant effect on first term reenlistment, especially if paid in a lump sum.

2. Military Compensation and National Economic Variables

Segregation of enlistees into occupational groups was undertaken by Reedy [Ref. 9] to investigate the differences in first term reenlistment rates among occupational groups due to economic variables. Nine occupational groups were used to categorize all navy ratings: Deck, Ordnance, Electronics and Precision, Administrative, Seaman,

Engine and Hull, Construction, Aviation, and Medical/Dental. Twenty years of first term reenlistment rates, from 1958 to 1977, drawn from Navy published reports were used as the dependent variable. The independent variables chosen were: the national unemployment rate, national wage data, unemployment rates for the major census occupational categories (white collar, clerical, sales, blue collar, and service workers), the ratio of military compensation to private sector wages, and unemployment and earnings rates for the standard industrial classifications (private household, construction, agriculture, service purchasing, and more). Reedy attempted to estimate the best single equation that would include the variables which were the most consistently significant (.05 level) over all of the nine groups.

Results of linear regression showed that the independent variables varied in significance over the nine groups. The national unemployment rate was significant in 7 of the groups. A lagged unemployment rate was significant in only 4 of 9 groups. The ratio of military compensation (base pay, BAQ, and tax advantage) to private sector wages was significant for all but the Seaman and Construction groups, and was positive in all cases. The coefficients for the compensation ratio were smaller than those for either the national unemployment rate lagged or not lagged. Reedy concluded that improving military compensation would be an uneconomic method of improving retention. For example, the Electronics and Precision group had the largest relative wage coefficient .84, but it would take a 19.3% compensation increase to raise the reenlistment rate 5 percent. The R square value of the models varied across the groups from a low of .51 for Medical/Dental to .84 for Electronics and Precision. The mean R square was .71.

Reedy's conclusions were that military compensation cannot reasonably be increased enough to counteract the effects of a strong economy at enlistment or reenlistment points. Further, the granting of reenlistment bonuses may have a greater effect on reenlistment than an across-the-board pay increase. Finally, Reedy concluded that unemployment and earning rates for different civilian occupational groups do not have as much an effect on the first term reenlistment rate as does the national unemployment rate, irrespective of age. This last conclusion will be examined in this thesis using the retention rates of Navy enlisted careerists.

The only study dedicated specifically to enlisted persons on their second or subsequent reenlistment was done by Bradley in 1980 [Ref. 10]. Bradley hypothesized that careerists' reenlistment behavior could be predicted by analyzing economic variables alone. Careerists were defined as those persons with at least seven years of service. Yearly data on careerists for the period FY 1956 to FY 1979 were used in the estimating equations derived by linear regression. All ratings were combined to obtain an aggregate reenlistment rate.

Independent variables used in the regression were Regular Military Compensation (base pay, married BAQ, sea pay), National Unemployment Rate, Mean Civilian Wages for regions with large naval populations, Military/Civilian pay ration, Civilian Wages of Navy Jobs, and a Consumer Price Index used to proxy civilian wage opportunities. Other economic variables were used but were rejected early in the analysis; those were: National Average Mortgage Rates, GNP, and Net National Income.

Bradley's results showed that three of the variables, Regular Military Compensation, National Unemployment Rate, and the Consumer Price Index of All Services Less Rent provided a R^2 of .774 when used together to predict the reenlistment rate of Navy enlisted careerists. This three variable model was used to predict the reenlistment rate for each year of the study. It came within 9.45 percentage points for each year, the mean error being only 3.48 percentage points. Lagging the unemployment rate did not improve the model. This contrasts somewhat with Reedy's result that a 6 to 9 month lagged unemployment rate is a better predictor variable, although Reedy's study covered only first term reenlistment.

The previous studies, with one exception, (Bradley), grouped the enlisted populations by either rating (Kleinman and Shugart), occupational group (Reedy, Haber and Stewart) or relative training cost (Drexler, Stewart). A different method of grouping enlisted personnel was conducted by Butterworth and Milch [Ref. 11] in a study to determine the feasibility of forecasting future states of the enlisted force. The loss behavior of all navy enlisted personnel during the period 1966 to 1972 was used. Ratings that exhibited similar loss behavior were grouped, or clustered. The hypothesis was that clustering by loss behavior may reflect a homogeniety in reenlistment attitude not apparent from the usual clustering by rating, paygrade, or occupational group.

The study tried a coarse grouping of only three clusters, and a finer grouping of ten clusters. The estimated loss rate for FY 1973 for each cluster was obtained from a weighted average of the actual loss rates during FY 1966-72. The same weighted average was used for

each rating, using no clustering. They concluded that no significant improvement in loss estimation could be found due to grouping by loss behavior. The study did show, however, that some ratings have loss characteristics in common that are not deducible from normal grouping schemes. For example, Dental Technicians and Aviation Machinist Mates had similar loss rates throughout the period, and there were other ratings showing very similar loss rates. The authors draw no conclusions from this occurrence. Finding a scheme to develop homogeneous groupings of enlisted personnel is necessary for the optimal application of Massell's model, so the contribution of studies such as Butterworth and Milch's should not be overlooked.

C. SHORTFALLS IN PREVIOUS RESEARCH

The number and variety of models used to predict reenlistment behavior suggest that more research is warranted. All of the predictive models reviewed concluded that economic variables are by far the most important predictors of reenlistment behavior for first termers (Massell, Reedy) and careerists (Bradley). The studies on the effect of the reenlistment bonus (Kleinman and Shugart, Stewart) were done during the period of the Variable Reenlistment Bonus (VRB). The VRB has been replaced by the Selective Reenlistment Bonus (SRB) and the Career Reenlistment Bonus (CRB), both of which can give higher cash awards relative to base pay than did VRB. A major limitation of the Kleinman and Shugart study is that they used cohorts of personnel entering the Navy during the height of the Viet Nam War. The anticipation or apprehension concerning the rapidly increasing role of the Navy during the escalation

of the 1960's may have influenced career decisions. In addition, the absence of a G.I. Bill post service education benefit from 1957 to 1965 may have affected the willingness of service members to remain on active duty.

Grouping methods are frequently necessary in order to have large enough sample sizes when analyzing reenlistment behavior. Of the methods reviewed, Massell's idea of homogeneous groups is conceptually pleasing, but not reinforced in her methodology. No mention is given of the actual number of cases in each of her six cohorts. Bradley developed a highly predictive equation but used a rather coarse all Navy grouping method - all Navy enlisted personnel who had greater than 7 years of service regardless of rate, sex, or age.

The Navy has separate staffs to monitor the manpower and personnel makeup of ratings according to a grouping method used to formulate manpower policy for individual ratings. The ratings are grouped so that each rating staff, called Enlisted Rating Coordinators, handles about 8 or 9 ratings with each rating handled as a separate entity. It is desirable, therefore, to estimate the effect on the Navy personnel structure at a by-rating level.

Haber and Stewart showed a positive correlation between VRB and first reenlistment, but the non-VRB group increased its reenlistment rate by 38.6%, whereas the VRB receivers increased by only 33.8%. Clearly, other factors affected their reenlistment decisions. Reedy concluded that most first term enlisted Navy personnel do not consider their pay to be really made up of items other than base pay. The standard RMC was not as effective a predictor of reenlistment behavior

as was base pay. When considering career petty officers, however, one would expect them to be more aware of the full extent of their compensation. Career petty officers are more likely to be married, and therefore are receiving a considerably higher quarters allowance relative to base pay. Bradley used RMC in his careerist retention equations, but did not compare it with the predictive value of base pay alone.

Finally, none of the studies researched for this thesis used the grouping scheme resulting from the Naval Enlisted Occupational Classification System (NEOCS) Study of 1974 [Ref. 12]. This thesis uses the NEOCS grouping scheme to test previous retention models and develop new equations intended to predict career petty officer retention rates.

TABLE 1

SUMMARY OF RETENTION LITERATURE

Author(s)	Data Set	Dependent Variable	Independent Variable(s)	Methodology and Results
Drexler (1975)	2522 Navy enlisted in 1972-73	First term reenlistment intention	Draft, Training costs, In-service experiences	Separated "true volunteers" from draft motivated enlistees. Classified ratings as low, medium, high training cost. True volunteers show greater intention to reenlist than draft avoiders. Cost of training completed positively correlated to reenlistment intention except for draft avoiders. In-service experiences are significant explainers of true volunteer reenlistment behavior but not for draft avoiders.
Stewart (1976)	Navy enlisted at EAOS in 1972	First term reenlistment rate	Training cost Training length N.E.C., VRB	Separated sample into sets according to training length and number of NEC's. Assumed training cost positively correlated with training length. Number of NEC's and training length were positively correlated with reenlistment. VRB had a positive but no statistically significant effect on reenlistment.

TABLE 1 (continued)

Author(s)	Data Set	Dependent Variable	Independent Variable(s)	Methodology and Results
Reedy (1978)	Navy enlisted 1957-1977	First term reenlistment	Unemployment Mil/civ pay ratio Civilian earnings War casualty count War dummy Military compensation	Separated ratings into 9 groups. Linear regression models showed different significant variables among rating groups. Unemployment significant when lagged 9 months. Relative wages significant in 7 of 9 models. War dummy significant in 5 of 9 models but sign was not consistent. Casualty counts not significant. Compensation significant but cannot be raised enough to compensate for a strong economy (low unemployment).
Kleinman & Shugart (1974)	Navy reenlistments 1966-1973	All term reenlistments	Reenlistment Bonus (VRB)	VRB presence accounts for 52% of variance in linear regression model, 45% in logit model, both for first term only. VRB did not have the hypothesized inverse relationship on later reenlistments. Concluded that VRB receivers as likely to become careerists as non-receivers.

TABLE 1 (continued)

Author(s)	Data Set	Dependent Variable	Independent Variable(s)	Methodology and Results
Haber & Stewart (1976)	Navy E-4/E-9 in 1971 and 1972	All term reenlistment rates	1971 pay raise VRB	Computed pay elasticity of four rating groups. Pay elasticity positive for first term. Later reenlistments not as effected by pay increase although reenlistment rate rose steadily with pay grade, possibly reflecting a strong positive effect of retirement eligibility at 20 year point.
Enns (1975)	All service 1971 first term reenlistments	First term reenlistment rate	VRB Base pay Enlistment age Civilian Ed. Civilian earnings Race	Linear regression showed VRB, Age, and non-white Race to be positively correlated with reenlistment. Civilian earnings education level and AFQT were negatively correlated. The sign and degree of significance varies between services. Reenlistment elasticity with respect to VRB was higher (3.4) than when respect to base pay (2.4). Elasticity was greater still when VRB was paid in lump sum rather than installments.

TABLE 1 (continued)

Author(s)	Data Set	Dependent Variable	Independent Variable(s)	Methodology and Results
Massell (1976)	White, male, Air Force enl. making first reen. decision in 1972	First term reenlistment Reenlistment	Military Compensation	The reservation wage (R) is the amount of compensation a serviceman would have to be offered to make him indifferent to reenlisting. Parameters obtained by linear regression. Reenlistment can be predicted by calculating the probability that R > RMC. In all cases in sample the R was larger than military compensation. Men with dependents behave as though having dependents means more pay received.
Bradley (1980)	E-6 and above reenlistments 1956-1979	Career reenlistment	RMC Unemployment Wage Index Mil/Civ pay ratio Other economic variables Draft	Reenlistment of career personnel can be predicted using economic variables of RMC, National unemployment, and Wage Index (Consumer priceindex). Draft had no significant affect on career reenlistment rate.

III. METHODOLOGY

A. RETENTION AND REENLISTMENT

Every person who initially enlisted in the Navy may believe that he/she will be allowed to reenlist if he/she chooses to do so at the end of the enlistment contract. Circumstances arise, however, that can render some persons ineligible to reenlist. A circumstance outside of individual control is a reduction in military strength ordered by the Secretary of Defense, or Congress. This occurred in the early 1970's as the nation's involvement in Southeast Asia wound down.

Other reasons that may cause a person to become ineligible for reenlistment are below-standard physical fitness, drug or alcohol dependency, regulation infractions, and age. The retention rate does not distinguish the loss of a person ineligible to reenlist from the loss of a person eligible to reenlist. Hence the retention rate is not as appropriate an indication of the aggregate desire of the service members to remain in the Navy. This is particulary a problem when measuring first term reenlistment roles.

It is reasonable to assume, however, that personnel who are designated as careerists are not very likely to become ineligible for further reenlistment due to drug or alcohol dependency, regulation infractions or other reasons of sub-standard performance. Rather, they leave the service mainly for one of two reasons - they reach the 20 year service point and are eligible for retirement with lifetime pension or they reach the age limit and are ineligible for further active duty.

Less than one-half of one percent of enlisted personnel over 25 years of service were over 50 years old during any given calendar quarter between 1973 and 1980.[1] Therefore, this study makes no distinction between careerist reenlistment rate and careerist retention rate. The quarterly career reenlistment rates for each rating are used as the measure of careerist retention.[2] This is necessary in order to utilize the available data contained in Navy Military Personnel Statistics (NAVPERS 15658).

B. DEFINITIONS

Throughout this study, various terms connected with retention behavior, such as "first termer," "careerist," and "career reenlistment," will be used. The definitions used are coincident with the Department of Navy definitions as contained in Navy Military Personnel Statistics (NAVPERS 15658) are are summarized below:

1. Pay Grade

Each person in the U.S. military is paid according to his or her level, or paygrade. Enlisted pay grades run from E-1 to E-10; officer pay grades from O-1 to O-10. Within each paygrade are sub-levels divided by length of service, for example "an E-4 over 4" means a person of paygrade E-4 having over 4 years of active military service.

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[1] Compiled from age distribution tables in NAVPERS 15658.

[2] In a study of first term reenlistment, Chow and Polich [Ref. 13] showed that for their cohort of 1976 service members, their findings would not differ significantly if they did not try to control for the difference between retention rate and reenlistment rate.

2. Rating

A rating is an occupation specialty made up of duties calling for closely related skills, abilities and aptitudes. The rating called Quartermaster, for example, encompasses the skills of celestial, terrestial, and electronic navigation; chart administration, and ship control seamanship. There are currently 110 ratings in use. New ratings are instituted when new equipment or new skills are required of an enlisted man such as the Gas Turbine Engineer rating which was created when the Navy started to use gas turbines as main propulsion systems of ships.

3. Rate

A rate is a combination of rating and paygrade. It identifies a person's occupation and level of attainment. Quartermaster rates vary from Master Chief Quartermaster (QMCM) down to Quartermaster Third Class (QM3).

4. Petty Officer

Naval enlisted personnel who have attained the pay grade E-4 are petty officers. A petty officer is classified and assigned by his/her rating and pay grade. For virtually all Navy members, this is the level at which both authority and responsibility are first conferred. The petty officer titles are as follows:

Pay Grade	Title
E-4	Third Class Petty Officer
E-5	Second Class Petty Officer
E-6	First Class Petty Officer
E-7	Chief Petty Officer
E-8	Senior Chief Petty Officer
E-9	Master Chief Petty Officer

5. First Term, Enlisted (First Termer)

An individual who is serving on an initial enlistment in the regular Navy, which may be for 4 or 6 years.

6. First Term Reenlistee

This is an individual who has completed an initial enlistment contract in the regular Navy, is discharged and reenlists in the regular Navy within 90 days following discharge. In order to reenlist one must first be discharged. Most frequently the discharge and reenlistment occur in the same ceremony. A person may also be discharged prior to the end of the initial enlistment contract for purposes of immediate reenlistment.

7. Career Reenlistee

This is an individual who reenlists for a second or subsequent time. The individual obligates himself for a third or subsequent enlistment contract.

8. Careerist

An individual making at least one career reenlistment is called a careerist.

9. Extension of Enlistment (Extension)

An individual may extend a current enlistment contract up to 4 years. While a bonus may be given for a reenlistment, no bonus is given for an extension of less than 3 years. An extension might be preferable for some individuals since a transfer to a new duty station does not normally follow an extension as it does for an reenlistment.

10. End of Active Obligated Service (EAOS)

The terminal date of an enlistment contract or extension is the end of active obligated service.

11. Reservation Wage

This is the measure of pecuniary returns just sufficient to induce an individual to reenlist. The reservation wage compensates an individual not only for foregone civilian pecuniary returns, but also for substituting military non-pecuniary benefits for those in the civilian world.

12. Reenlistment Rate

This is the rate at which those who are eligible to reenlist do so or extend for 24 or more months.

$$\frac{\text{Reenlistments + Extensions of 24 or more months}}{\text{Eligibles at EAOS}} = \text{Reenlistment Rate}$$

13. Retention Rate

The rate at which all personnel, both eligible and ineligible, either reenlist or extend 24 or more months is the retention rate.

$$\frac{\text{Reenlistments + Extensions of 24 or more months}}{\text{All Personnel at EAOS}} = \text{Retention Rate}$$

C. GROUPING THE NAVY RATINGS

To conduct this study with as many data points as possible, quarterly reenlistment data are used. This is the shortest time period for which reenlistment data are easily obtainable. However, using quarterly data for most ratings means that the number of career eligibles and reenlistees in a rating are quite small, frequently less than 20 individuals. Therefore, it is necessary to group ratings by a method that would not only result in cells having a larger number of observations, but which would also maintain cell homogeniety.

Several methods exist for grouping the 110 Navy ratings. The Chief of Naval Personnel (CHNAVPERS) groups all ratings into 10 sets when summarizing reenlistment statistics in NAVPERS 15658. The groups are: Deck, Engineering and Hull, Construction, Ordnance, Precision, Electronics, Administrative, Aviation, Miscellaneous, and Medical. This is basically the method used by Reedy [Ref. 9] in her analysis of first term reenlistment. The fault with this grouping method is that CHNAVPERS personnel policy is not made on the basis of these groups.

A second method has been adopted by the Deputy Chief of Naval Personnel for Manpower, Personnel, and Training (OP-01). Each Navy rating is grouped into one of 14 "communities." Ratings within each community are similar in skill requirements and functions involving operation and maintenance of related equipment. As can be seen in Table 2, each community is given a general title roughly describing the ratings' activities. Each community is under a separate staff's cognizance, called the Enlisted Community Manager (ECM). The ECM is responsible for monitoring the training pipeline and population of each rating in his community. As will be seen, the grouping scheme is similar to the official Navy Department method, but contains fewer groups and therefore does not discriminate as finely among the ratings. It is felt by OP-01 that one staff headed by an O-5 can successfully monitor 6 to 9 ratings. Some ratings have been changed from one community to another in order to balance out the ECM's workload. The ECM's do not make policy decisions concerning the welfare or strength of their communities. Rather, they act as liaison between the many staffers within the Navy who do have a part in policy formation such

TABLE 2

OCCUPATIONAL GROUPING FOR ENLISTED COMMUNITY MANAGERS

COMMUNITY	RATINGS
Combat Systems	DS, EW, FT, GM, OS, STG,
Communications/ Operations	DP, ET, OT, RM
Deck/Hull	BM, HT, IM, ML, MR, OM, PI, PM, QM, SM
Submarine/Nuclear	FTB, MN, MT, STS, TM
Aviation ASW Support	AG, AIRCREW, AW, AX, AZ, PH
Aviation Avionics	AC, AE, AQ, AT, AV, TD
Aviation Mechanical	AB, AD, AF, AM, AO, AS, PR
Cryptologic	CTA, CTI, CTM, CTO, CTR, CTT
Administrative	DM, IS, JO, LI, LN, MU, PC, PN, RP, YN
Supply	AK, DK, MS, SH, SK
Medical/Dental	DT, HM
Construction	BU, CE, CM, CU, EA, EO, EQ, SW, UT
Special Warfare	UDT/SEAL/DIVER, EOD, MA, NC

Source: Navy Enlisted Community Manager's Manual

as the Chief of Naval Personnel, Chief of Naval Training, Chief of Naval Recruiting, to name a few. For this reason it was decided not to use the OP-01 method to group ratings for this study.

A third method for grouping ratings is used by the Chief of Naval Recruiting in the U.S. Navy Enlisted Career Guide [Ref. 14]. The guide is published for use by local recruiters and is available to schools and guidance counselors. To facilitate its use, Navy ratings are grouped similarly to the system used in the Occupational Outlook Handbook published by the U.S. Department of Labor, Bureau of Labor Statistics [Ref. 15]. Ratings with similar characteristics are again grouped together, as can be seen in Table 3. This grouping scheme was not used in this thesis since it is done only to aid recruiters and potential recruits.

During the period of July 1973 to January 1974, an extensive review of the enlisted classification system was conducted.[3] The study's purpose was to evaluate the existing system and make recommendations as to the skills required for each rating and the actual number and type of ratings which should exist. After analysis of each rating, the study formulated a plan to consolidate a number of independent ratings on the basis of commonality and similarity of skills. The existing ratings were grouped into 24 homogeneous occupational fields. Although the consolidation plan has not been adopted, the 24 occupational field scheme has remained. The grouping of ratings

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[3]The Naval Enlisted Occupational Classification System (NEOCS) SNDY.

TABLE 3

OCCUPATIONAL GROUPING METHOD USED BY THE CHIEF OF NAVY RECRUITING

Occupational Group	Ratings
Clerical and Administrative	AZ, AK, CTA, DK, PN, RP, SK, YN
Communications	CTO, DM, IS, JO, LI, MU, PH, RM, SM
Construction	BU, CE, EA, EO, SW, UT
Data Processing	DP
Health	DT, HM
Manufacturing	HT, ML, PM
Mechanical and Repair	AD, AO, AM, AS, BT, CM, EN, MR, MM
Scientific and Technical	AG, AW, AX, AE, AQ, CTR, CTI, CTM, CTT, DS, EM, ET, EW, FT, GS, GM, IM, IC, MN, OT, OS, OM, ST, TM, TD
Service	MS, PC, SH
Transportation	PR, AC, AB, BM, QM
Petty Officer Ratings	LN, MA, NC
Navy Diver Programs	EOD, Special Warfare, Navy Diver

Source: Navy Recruiting Manual [Ref. 16].

Note: Although all 110 ratings are not written above, all are implied. That is, the GM rating contains the ratings GMG, GMM, GMT; the ET rating contains ETR, ETN. These three letter ratings are in effect for E-4 to E-5. When an individual reaches E-6, the third letter is usually dropped.

in the fields was done on the basis of a blending of skills between ratings that had occurred over the years. The titles of the fields are closely related to functions performed aboard ship, in aircraft squadrons, and in shore activities. They are descriptive of the work men and women actually do, and they follow the systems concept. Table 4 lists the occupational fields and their associated ratings.

The study group defined a system as an "assemblage of equipment, documentation, and trained personnel having regular interaction and interdependence and geared toward support of one or more major command functions."[4] An occupational field encompasses all ratings which may reasonably be required to man and support the system to which it is aligned.

The occupational field method results in the most homogeneous groups of all the methods researched. It is the result of a full-scale Navy sponsored study of the Navy Enlisted Classification System. This is the grouping method selected for use in this study. An additional advantage is that Navy sponsored research is currently underway using the occupational field scheme in a study of first term reenlistment.[5]

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[4]Navy Enlisted Occupational Classification System (NEOCS) Study, Vol. 1, p. 17.

[5]Naval Personnel Research Development Center, San Diego, is conducting a study of how first term reenlistment is related to in-service experience. Data on reenlistment and experiences are being grouped by occupational field.

TABLE 4

NAVY ENLISTED OCCUPATIONAL FIELDS

Occupational Fields	Ratings
General Seamanship	BM, SM
Ship Operations	OS, QM
Marine Engineering	BT, EM, EN, GS, IC, MM
Ship Maintenance	HT, IM, MR, ML, OM, PM, BR
Aviation Maintenance/Weapons	PR, AX, AE, AT, AQ, AD, AZ, AO, AM, AV, AF
Aviation Ground Support	AB, AS
Air Traffic Control	AC
Weapons Control	ET, FT
Ordnance Systems	GM, MN, MT, TM
Sensor Operations	EW, OT, ST
Weapons System Support	TD
Data Systems	DP, DS
Construction	BU, CE, CM, EA, EO, SW, UT, EQ
Health Care	DT, HM
Administration	LN, NC, PN, PC, YN, RP
Logistics	AK, DK, MS, SH, SK
Media	DM, JO, LI, PH
Musician	MU
Master-at-Arms	MA
Cryptology	CT
Communications	RM
Intelligence	IS
Meteorology	AG
Aviation Sensor Operations	AW

Source: [Ref. 12]

D. THE DEPENDENT VARIABLE - CAREER REENLISTMENT RATE

Career reenlistment data were taken from the quarterly publication NAVY MILITARY PERSONNEL STATISTICS (NAVPERS 15658). This publication has a section entitled "USN Reenlistment Data, First Term and Career Personnel." For each rating, the number eligible (ELIG REEN), number of reenlistments (NO. REEN) and the reenlistment rate (REEN RATE) is given for each of the 9 categories shown below:

NAVPERS 15658 CATEGORY	PAY GRADE
CM	E-9
CS	E-8
C	E-7
1	E-6
2	E-5
3	E-4
Total PO	E-9 + ... + E-4
Strikers	E-1 + E-2 + E-3
Total	PO + Strikers

The reenlistment rate is calculated as follows:

$$\text{REEN RATE} = \frac{\text{REEN}}{\text{ELIG REEN}}$$

where formally:

REEN = reenlistments executed within 90 days of EAOS + number of extensions for 24 or more months

ELIG REEN = number eligible to reenlist prior to expiration of service + number eligible at expiration of service + number of extensions for 24 more months.

Personnel are not counted twice. For example, a person who is eligible to reenlist but extends is only counted as an extension.

The reenlistment data in NAVPERS 15658 are presented only for the fiscal year's total to date. Data are presented for first term, career and total personnel.

Since quarterly data were desired it was necessary to subtract the previous quarter's cumulative data for the eligibles and reenlistees for each rating. The ratings were then grouped by occupational field and reenlistment rates were computed for each field. Appendix A shows the resultant reenlistment rates. The numbers in parenthesis are the number of eligibles in each occupational field for each quarter 1976-1980. The aggregrate quarterly reenlistment rate was computed by dividing the total quarterly career reenlistments by the total number of eligible persons in each quarter.

E. PREDICTORS FOR REENLISTMENT

1. Career Regular Military Compensation (CRMC)

There is no uniform agreement on exactly which combination of the many components of military compensation is most representative of an individual's perceived compensation. Various schemes for constructing a military pay variable were discussed in Chapter II. One of the problems encountered in reviewing previous methods was in obtaining precise definitions of the pay variables. There is agreement, however, that base pay is the most significant component of military compensation [Refs. 1, 2, 3, 4, 5, 6]. This component not only reflects the individual's pay grade but also approximate time in service. Automatic increases in base pay occur at the 2, 3, 4, 5, 6, 8, 10, 12, 14, 16 and 18 year points.

The base pay component required a determination of the most representative time in service interval for the careerist pay grades, E-6 to E-9. For two sample years, 1976 and 1980, the time in service of each enlisted person on active duty was tabulated and it was found that 90% of all E-6 to E-9 personnel in both years have between 8 and 26 years of service. It was assumed that this percent did not change significantly during the years between 1976 and 1980.

To calculate an estimate of CRMC, the proportion of the career force in each of the pay-grades E-6 to E-9 had to be determined. The number in each paygrade was divided by the total force for fiscal years 1976 and 1980. The resulting proportions are shown in Table 5. These proportions were used to weight the average base pay for each paygrade. The careerist base pay component was formed by summing these weighted base pays.

TABLE 5

PROPORTION OF CAREER FORCE BY PAYGRADE
1976 AND 1980

Paygrade	1976+1980	Percent of Total
E-6	131679	61.3
E-7	60331	28.1
E-8	16159	7.5
E-9	6499	3.1
Total	214668	100.0

Mathematically, the base pay component was calculated as follows:

$$\text{Base pay} = \frac{\sum_{i} Xi}{Y}$$

Where formally:

xi = Base pay given i years of service

Y = Number of different base pay categories, 6 for E-6, 8 for E-7, E-8, and E-9

i = Base pay increment categories, 8, 10, 12, 14, 16, 18, 20, 22 years of service

The difference in denominators between E-6 and E-7/8/9 is because an E-6 receives only 6 pay increases due to time in service, while E-7 and above receive 8. Less than five percent of all E-6's have over 20 years of service, whereas 25, 46, and 77 percent of E-7/8/9 personnel have over 20 years time in service, respectively.[6]

The next compensation component considered was the basic allowance for quarters (BAQ) amount. BAQ differs considerably depending on whether the service member has dependents. For example, an E-6 without dependents in 1976 received $136.50; with dependents $213.50. Table 6 shows the percent of E-6 to E-9's receiving full BAQ during the period 1969 to 1980. The 1976 to 1980 percentages were used as weights in computing the appropriate BAQ component of military compensation. The percentages for 1969 to 1975 are shown in the table to show the stability of the percentages over the past eleven years.

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[6]Average percentages over all quarters of the study. Computed from tables available in NAVPERS 15658.

TABLE 6

PROPORTION OF E-6 TO E-9 RECEIVING FULL BAQ*

Fiscal Year	E-6	E-7	E-8	E-9	AVG
1969	86.3	93.8	96.1	96.6	93.2
1970	87.3	84.1	96.3	96.2	93.5
1971	88.0	94.4	96.5	96.5	93.9
1972	87.9	93.9	95.8	96.3	93.5
1973	89.2	93.7	96.0	96.0	93.7
1974	90.8	95.2	96.9	97.5	95.1
1975	84.9	89.0	90.9	91.6	89.1
1976	88.9	92.9	95.3	95.3	93.1
1977	90.1	95.0	97.1	97.4	94.9
1978	89.8	94.9	97.1	97.8	94.9
1979	89.2	94.9	97.1	97.5	94.7
1980	88.0	94.6	96.7	97.8	94.3

Source: Defense Manpower Data Center, Monterey, California

*A person receiving "full BAQ" necessarily has one or more dependents

The 1973 BAQ component for paygrade E-6 was computed as follows:

(E-6 BAQ with dependents)	x	(1973 pct E-6 with dependents)	
($150.00)	x	(.892)	= $133.80
(E-6 BAQ w/o dependents)	x	(1973 pct of E-6 w/o dependents)	
($95.70)	x	(.108)	= $ 10.33
		1973 BAQ component for E-6	$144.13

The next compensation question was how to account for other components of military compensation such as sea pay, flight pay, submarine pay, hazardous duty pay, diving pay, proficiency pay, reenlistment bonuses still being paid by installments, commuted rations, family separation allowance, uniform maintenance allowance and the tax advantage on allowances. In addition, non-pecuniary considerations such as exchange and commissary privileges, medical care, low cost life insurance and low cost recreational services may be viewed as a part of compensation. Since no individual service member receives all of these components at once, a method of standardizing these compensations had to be computed.

In considering the pecuniary candidates it is impossible to determine by occupational rate alone which of the pays a service member receives. An Operational Specialist can receive sea pay, submarine pay, hazardous duty pay, diving pay, proficiency pay or a combination of these pays. To determine the frequency of each pay among all careerists for each quarter would involve investigation of each and every service record. It would be extremely time consuming and laborious to investigate every service record to obtain data on

all the special pays an individual receives. In addition to this difficulty, it would be of questionable value. Up until October 1980, the magnitude of these special pays was quite small in relation to base pay and BAQ so the average addition to everyone's pay would be quite small. The sole exception to the above argument might be in the receiving of flight pay by some individuals in the aviation occupational fields. Unfortunately, it is as difficult to determine how many individuals in the aviation fields are in flying billets as it is to determine how many in the general seamanship field are on sea duty. It is therefore a key assumption of this study that the receivers and non-receivers of the special pays are distributed evenly over the occupational fields and that the net effect of including the pays would not significantly alter the effect on reenlistment rates of the magnitude or variation of the constructed military compensation variable over the 20 quarter time period of this study. The October, 1980, pay hike added two components of pay, Career Sea Pay and Variable Housing Allowance, which do change the distribution of RMC significantly. A future extension of this research may be able to take those special pays into account.

The non-pecuniary components of military pay were not used for reasons similar to those for the special pay components. The frequency of use of the available shopping and recreational facilities could not be reliably estimated.

The 1973 CRMC is calculated below as an example:

E-6 base pay average for time in service 8 to 20	= $612.35
E-6 BAQ component	= $144.13
Total	$756.48

(1973 E-6 component of CRMC) x (E-6 proportion of the career force)

(756.48) (.613) = $463.72

The same computation is done for E-7 to E-9 with the following results:

1973 E-6 component =	$463.72
1973 E-7 component =	$242.31
1973 E-8 component =	$ 72.79
1973 E-9 component =	$ 29.88
Total 1973 CRMC	$808.70

Table 7 shows the CRMC computed for years 1976 to 1980. As can be seen in this table, money CRMC increased almost 28% from fiscal year 1976 to fiscal year 1980.

An additional consideration in the military compensation variable was to account for the periodic service-wide pay increases. The yearly pay increase is usually effective as of the beginning of the fiscal year. The beginning of the fiscal year was changed in 1976 from 1 July to 1 October. The actual occurrence of the yearly pay increases over the years 1976 was investigated and used in the military compensation time series showing the quarter by quarter CRMC.

TABLE 7

E-6 TO E-9 CAREER REGULAR MILITARY COMPENSATION (CRMC)

1976 - 1980

Fiscal Year	CRMC
1976	$ 946
197T	$ 946
1977	$1004
1978	$1062
1979	$1116
1980	$1207

A final consideration in developing the CRMC variable was to account for the effect of nationwide inflation upon military pay. Table 7 shows that military compensation has increased and Appendix A shows that career retention, in general, has declined. This implies an inverse relationship. Logically, an increase in compensation should result in an increase in retention. It was necessary to convert yearly dollars into real dollars to show the difference in buying power that has occurred over the period of the study.

The U.S. Department of Labor, Bureau of Labor Statistics (BLS) [Ref. 18] deflates earnings data to constant 1967 dollars using the seasonally adjusted consumer price index (CPI). The CPI measures price changes in the total of goods and services purchased by urban single and family wage earners and clerical workers. Basic and adjusted data for the price index are published by the BLS which also provides the seasonal adjustment factors used to adjust the index.

A purchasing power index was created from the "consumers prices, all items" index by dividing the middle month index value for each quarter into the middle month CPI index of the third quarter for FY 1980. These values are in column two Table 8. As indicated, a hundred dollars in 1976-1 had the same purchasing power as 150 dollars in 1980-3. The actual CRMC was multiplied by the purchasing power index to obtain the adjusted CRMC. As can be seen in Table 8, the adjusted CRMC shows a general decline of real wages over the period 1976 - 1981 which follows the logical relationship of compensation to retention. Table 8 indicates that real CRMC decreased over 15% from fiscal year 1976 to FY 1980.

In order to use CRMC as a predictor variable for FY 1980-4 and FY 1981-1, the relatively large increase in military compensation due to the institution of Career Sea Pay (CSP) and Variable Housing Allowance (VHA) was taken into account. Precise weighting of the various levels of CSP and VHA among the career pay grades was not done at the level that base pay and BAQ were. Instead, it was conservatively estimated that the average careerist has between 2 and 5 years of sea duty, and receives some VHA. Since the October 1980 pay raise was well publicized in the quarter prior, it was estimated that careerists made their reenlistment decision with a perceived CSP and VHA in FY 1980-4. Accordingly, before accounting for inflation, the FY 1980-4 CRMC was increased by $150, and the FY 1981-1 CRMC by $300.

TABLE 8

E-6 TO E-9 CRMC ADJUSTED FOR INFLATION BY QUARTER

FY-QTR	Purchasing Power Index	Real CRMC
1976-1	1.50	1424
1976-2	1.48	1399
1976-3	1.47	1387
1976-4	1.45	1369
197T	1.42	1348
1977-1	1.38	1389
1977-2	1.38	1389
1977-3	1.36	1366
1977-4	1.34	1342
1978-1	1.32	1403
1978-2	1.30	1380
1978-3	1.27	1345
1978-4	1.24	1315
1979-1	1.21	1353
1979-2	1.18	1319
1979-3	1.14	1277
1979-4	1.11	1236
1980-1	1.08	1299
1980-2	1.04	1250
1980-3	1.00	1207
1980-4	.98	1330
1981-1	.96	1574

2. Unemployment (UNEMP)

The civilian unemployment rate for males between 25 and 39 years old was chosen as the variable most representative of the civilian job opportunity environment faced by the career petty officer. It has already been established that over 90 percent of careerists have at least one dependent. A petty officer leaving the service prior to, at or after the 20 year point will therefore probably seek further employment to support his family. By definition, a careerist has at least 7 years of active duty and only a very small percentage have over 26 years. Table 9 shows that 85.03 percent of careerists are between the ages of 25 and 39. A person who enlisted at age 18 would be in his/her seventh year of active duty at age 25. If a careerist left the service at the 20 year point, he/she would be in his/her 39th year. Since the percentage of females meeting the careerist definition did not exceed one percent during the period 1973-1980, it was decided to use civilian male unemployment data for age group 25-39 as the appropriate civilian unemployment variable.

TABLE 9

E-6 TO E-9 AGE DISTRIBUTION FY 1976 + FY 1980

Age Group	Number in Group	Percent of Total
Under 25	3551	1.65
25-29	44354	20.66
30-34	69983	32.60
35-39	68202	31.77
40-44	17638	8.22
45-49	4986	2.32
50-54	1308	.61
Over 54	4646	2.17
Total	214668	100.00

Source: Defense Manpower Data Center, Monterey, California

Data were available for age groups 25-29, 30-34, and 35-39. The 25-39 unemployment rate was computed by taking a simple average of the rates for the three age groups. Table 10 shows unemployment by age distribution by quarters for 1973-1980.

TABLE 10

CIVILIAN MALE UNEMPLOYMENT BY AGE GROUP

FY-QTR	25-29	30-34	35-39	25-39*
1976-1	7.60	5.00	4.47	5.69
1976-2	7.07	5.10	4.63	5.60
1976-3	8.27	6.23	5.23	6.58
1976-4	6.50	4.83	4.13	5.15
197T	6.83	4.43	3.87	5.04
1977-1	7.00	4.50	4.13	5.21
1977-2	8.87	5.27	4.87	6.34
1977-3	6.40	4.30	3.33	4.68
1977-4	5.83	4.30	2.90	4.34
1978-1	5.43	4.17	3.13	4.24
1978-2	6.57	4.47	3.53	4.86
1978-3	4.70	3.10	3.07	3.62
1978-4	4.63	2.77	2.43	3.28
1979-1	4.95	3.10	2.55	3.53
1979-2	6.17	3.90	3.20	4.42
1979-3	4.30	3.13	2.60	3.34
1979-4	4.27	3.27	2.77	3.44
1980-1	4.67	3.33	3.20	3.73
1980-2	4.87	5.73	4.43	5.01
1980-3	4.43	5.47	4.40	4.77

Source: U.S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings (yearly) [Ref. 17].

*Computed by averaging the 25-29, 30-34 and 35-39 rates

3. Indicators of Civilian Economic Conditions Other Than Unemployment

The perceived value of a person's potential civilian earnings may have an effect on his reenlistment decision. It is desirable, therefore, to develop variables that would represent the civilian wages available. Obviously the perfect case would be where one knew exactly what wage each and every careerist would make if he/she left the service. This data is impossible to obtain and in any case it would be used to construct an average for all careerists in each occupational field. The least precise measure would be the mean national wage found by aggregating over all civilian occupations. Two measures of civilian earnings conditions were considered in this study: Index of all services less rent and average weekly earnings in selected civilian occupations.

a. Index of All Services Less Rent (SVCS)

The index of all services less rent was used by Bradley (1980) as a proxy for change in civilian wages. The index was developed by using a consumer price index of services tabulated in the Economic Report of the President, published annually. The index, as it appears in the publication, is calculated by pricing the services that people buy for day to day living such as medical, home and auto maintenance, postal charges, utilities, property taxes, and insurances [Ref. 11]. Price changes for these items are averaged for major U.S. cities and 28 rural locations. Since the index of all services less rent excludes prices of rents and mortgages, the majority of the items comprising the index are services that are

supplied by personal labor. Changes in this index become a proxy for changes in wage that a careerist might receive if he/she decides not to reenlist, but rather to enter the civilian job environment. Table 11 shows the index computed quarterly from FY 1973 to FY 1980 with the third quarter FY 1980 equalling 100.

TABLE 11

INDEX OF ALL SERVICES LESS RENT

3rd QTR FY 1980 = 100

FY-QTR	Index
76-1	61
76-2	62
76-3	64
76-4	65
7T	66
77-1	67
77-2	69
77-3	70
77-4	72
78-1	73
78-2	74
78-3	76
78-4	78
79-1	80
79-2	82
79-3	84
79-4	87
80-1	91
80-2	95
80-3	100

b. Average Weekly Earnings in Selected Private, Non-Agricultural Industries (EARN)

Even though a careerist who leaves the service carries experience, leadership ability and maturity, he/she may very well be initially be given a non-supervisory position by a civilian employer. It may be reasonable to assume that a new employee would have to prove to his/her employer that he/she does, in fact, possess skills transferable from the military.

The yearly Economic Report of the President [Ref. 19] lists the average gross weekly earnings for production or non-supervisory workers for eight major civilian occupation fields: manufacturing, construction, retail trade, mining, transportation, public utilities, finance, insurance and real estate.

The NEOCS grouping of the occupational fields utilized navy specific rationale of similar work components such as similar skills, similar duty assignments, similar working conditions and similar watch stations. Civilian counterparts to navy ratings were not explicitly used as a grouping method in the NEDCS study. This study will utilize an aggregate measure of average gross weekly earnings instead of a civilian job specific or industry specific measure. Future research may investigate the relationship between military and civilian jobs and apply the similar jobs' earnings as civilian wages of navy jobs.

Table 12 shows the average gross weekly earnings index with FY 1980-3 as the base quarter.

TABLE 12

AVERAGE GROSS WEEKLY EARNINGS (EARN)

FY-QTR	Total
1976-1	71
1976-2	73
1976-3	75
1976-4	76
197T	76
1977-1	80
1977-2	79
1977-3	81
1977-4	83
1978-1	84
1978-2	85
1978-3	88
1978-4	89
1979-1	91
1979-2	93
1979-3	93
1979-4	96
1980-1	98
1980-2	99
1980-3	100
1980-4	103
1981-1	106

4. Relative Wages (RW)

A method of combining the possible effects on career retention behavior of changes in either military compensation or alternative wages is to utilize the ratio of military to civilian pay as a single explanatory variable. The career petty officer at a reenlistment decision point might investigate the pay scale of civilian jobs requiring similar skills to his military occupation. A ratio of total military compensation to total civilian compensation, including quantified non-pecuniary aspects of both, is the ideal ratio. An increasing ratio should result in a correspondingly increasing reenlistment rate.

A military/civilian pay ratio was computed by Bradley using his CRMC and Mean National Wages.[7] The Mean National Wage was adjusted to include some fringe benefits in order to make civilian wages reflect some of the non-paycheck benefits in his compensation. Reedy [Ref. 8] constructed her relative wage variable for first termers by using base pay for E-4's with less than four years of service, divided by private sector non-agricultural wages for production or non-supervisory personnel. A related variable which recognized the value of indirect financial benefits was based upon the RMC for E-4's with less than four years of service. Her RMC included quarters and subsistence allowances and the tax advantage associated with them, as well as base pay. The latter was less

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[7] Bradley used data taken from the same table used by this study, Average Gross Weekly Earnings.

effective for the sample over which it was tested, and Reedy inferred that base pay is the major component of military compensation considered by the typical first termenlistee.

The relative wage variable constructed for this study takes CRMC divided by 4 to obtain a weekly CRMC, then divides that by the average gross weekly earnings amount for production or non-supervisory workers used to construct the earnings index. Table 13 shows the ratio of military to civilian wages. For the period 1976-1 to 1980-3 the military/civilian wage ratio decreased by just over five percent.

F. PREDICTING CAREER RETENTION USING MASSELL'S EQUATION

An alternative method, following Massell's work [Ref. 5], for predicting career retention is to calculate the reservation wage for each occupational group and to determine the probability of reenlistment for each.

The equations used for computation of the reservation wage and the probability of reenlistment were discussed in Chapter II. Linear regression equations are developed for each occupational field reenlistment rate, and for the aggregate reenlistment rate using the adjusted CRMC as the single explanatory variable. While Massell used historic reenlistment data for just one year, FY 1972, this study uses the twenty calendar quarter time series. Once the reservation wage is calculated, the probability of reenlistment given any military wage can be estimated.

TABLE 13

MILITARY/CIVILIAN WAGE RATIO (RW)

FY-QTR	Total
1976-1	1.38
1976-2	1.37
1976-3	1.36
1976-4	1.35
197T	1.34
1977-1	1.39
1977-2	1.36
1977-3	1.33
1977-4	1.32
1978-1	1.37
1978-2	1.35
1978-3	1.31
1978-4	1.29
1979-1	1.33
1979-2	1.31
1979-3	1.29
1979-4	1.25
1980-1	1.33
1980-2	1.31
1980-3	1.31
1980-4	1.44
1981-1	1.67

G. METHOD OF LINEAR REGRESSION ANALYSIS AND MODEL VALIDATION

1. Stepwise or Hierarchical Regression

There are two basic methods of adding independent variables into a multiple linear regression model equation. In the stepwise method the independent variables are entered according to their contribution to the overall coefficient of determination, R square. Using this method the change in importance of the same variable across the 24 occupational fields can be readily seen. In the second method, the hierarchical method, variables are added to the regression equation in an order determined by the researcher. For this study, it is assumed that there exists no intrinsic order to the occurrence of the independent variables in society, therefore, stepwise regression is used throughout.

2. Model Validation

Three specific steps will be performed to validate the developed predictive models: (1) a measure of the goodness of fit of the overall model will be calculated, (2) tests for the statistical significance of individual variables in each model will be accomplished and, (3) the models will be tested on actual reenlistment rates not used in developing the equations.

The goodness of fit test involves testing the null hypothesis that the equations are not significant at the .05 level. The F statistic of each equation is used to determine the significance level. The R square statistic is used to describe the amount of variance in the reenlistment rate that is explained by each model.

The significance test for each of the independent variables involves using the F statistic to test the null hypothesis that the variable is not significant at the .05 level.

In the third test, the predicted reenlistment rate is found by using the models to predict the career reenlistment rates for quarters FY 1980-4 and FY 1981-1. A model for an occupational field is considered successful by this researcher if it predicts the reenlistment rate for each calendar quarter within $\pm$ 5% of the actual rate.

3. Omission of Selected Occupational Fields

Occupational fields containing less than 50 persons eligible for reenlistment in an average quarter were deleted from further study. An individual decision to reenlist or not has more of an effect on these smaller occupational fields and might result in misleading conclusions about general group behavior. The following occupational fields were therefore omitted: Air Traffic Control, Weapons System Support, Musicians, Master-at-Arms, Intelligence, Meteorology, and Aviation Sensor Operations.

The remaining 17 occupational fields and the aggregate rating group each contain different amounts of eligibles and reenlistees. To indicate the usefulness of each model, the percentage of the FY 1981-1 career force working in the ratings covered by the successful models is mentioned in the results.

4. Models Developed

Prediction equations are developed for each of the 17 occupational fields and the aggregate reenlistment rate. In evaluating any model two points were considered: how well does the model fit the

historic data, and how well does it predict future reenlistment rates? If policy analysis is the purpose of a modeling effort, then validity as measured by goodness of fit to historic data is important. If prediction is the purpose, then causally incorrect or incomplete models can still be valuable if they predict well. The models developed in this thesis are judged on both points.

Single variable models are developed using CRMC, then unemployment as the explanatory variables. Massell's model, a variation on single variable models, is then evaluated as to its predictive value. The final model uses the best military/civilian relative wage variable combined with unemployment.

IV. RESULTS

A. SINGLE VARIABLE MODELS

1. CRMC

CRMC is the inflation adjusted value of Career Military Compensation. As shown in Table 16, CRMC as the sole explanatory variable results in R^2's between .01 and .42 for predicting careerist retention in the occupational fields. Only 1 of the 18 models has an R^2 greater than .40; that being the model for Aviation Ground Support, which contains only 2.2% of the personnel in the FY 1981-1 career force. Table 14 also shows that in only 2 occupational fields, Ship's Operations and Health Care are the predictions of the FY 1980-4 and FY 1981-1 retention rates within $\pm$ 5% in both calendar quarters. The mean error for the 18 models is 9.3%.

CRMC alone appears to have neither good explanatory value nor predictive usefulness. This is not surprising, in that the true value of compensation to a service member needs to reflect the opportunity cost of military service. CRMC by itself does not reveal whether the person is in a better or worse financial situation than he might be if he left the service. A compensation variable incorporating a measure of civilian wage alternatives should prove to predict better past reenlistment behavior and to be a better predictor of future behavior.

2. Unemployment

When 25-39 the year old male unemployment rate is used as the sole explanatory variable, the R^2's vary from .02 to .58. The fields

TABLE 14

ACCURACY OF SINGLE VARIABLE MODEL USING CRMC IN PREDICTING CAREER RETENTION RATES

Occupational Field	Predicted Retention 1980-4	Predicted Retention 1981-1	Percent Deviation from Actual 1980-4	Percent Deviation from Actual 1981-1	R^2	Level of Significance
General Seamanship	79.3	98.4	4.9	16.7	.37	.01
Ship's Operations	72.1	87.3	1.1	3.8	.24	.05
Marine Engineering	57.1	72.0	-7.8	6.2	.23	.05
Ship's Maintenance	73.5	95.2	3.7	15.8	.31	.05
Aviation Maint/Weaps	65.2	83.1	0.9	23.1	.30	.05
Aviation Ground Support	72.5	94.8	-5.4	15.2	.42	.01
Weapons Control	41.8	29.4	-12.4	-47.5	.26	.05
Ordnance Systems	73.1	74.9	-2.4	-12.6	.01	NS
Sensor Operations	52.0	58.6	-7.1	-5.0	.05	NS
Data Systems	55.	71.1	-6.9	13.0	.09	.25
Construction	78.8	89.0	-5.2	-9.0	.07	NS
Health	71.8	78.6	1.7	4.8	.08	.25
Administration	77.9	92.3	-3.4	7.9	.23	.05
Logistics	84.5	102.5	1.8	18.6	.37	.01
Media	75.7	75.9	0.9	-11.3	.02	NS
Cryptology	69.9	55.7	-6.8	-30.4	.29	.05
Communications	72.	81.8	-5.1	3.8	.12	.25
Aggregate Ratings	66.6	77.0	-8.5	4.1	.24	.05

which have an R^2 greater than .40 comprise 58% of the 1st Quarter of FY 1981 (FY 1981-1) career force. Unemployment has a significant coefficient at the .05 level or higher in 13 of the 18 models. The FY 1980-4 and FY 1981-1 career retention rates for four fields are successfully predicted with $\pm$ 5% of the actual rates. These fields, Aviation Maintenance/ Weapons, Health, Logistics, and Communications, include 37% of the personnel in the FY 1981-1 career force. The mean error of prediction is 8.5%. Table 15 summarizes the results of unemployment as a single explanatory variable.

Unemployment, specific to the age group which contains career petty officers, has a better fit to historic reenlistment data and is a substantially better predictor of future career retention than CRMC alone. This result suggests that the opportunity for employment in the civilian job market affects the career reenlistments of middle grade and senior enlisted personnel more than the fluctuations in their military compensation. Previous studies, [Refs. 6, 7, 9, 10] recognized the significance of unemployment, however, none attempted to narrow the unemployment to a specific age group or use it as a single explanatory variable.

The unemployment rate for this study was not lagged. Future research might use various time lags to attempt to correspond with the employment rates publicized by the media. An increase in significant or predictive value of the unemployment variable when lagged might lead to the conclusion that career reenlistments are largely based on the perception of civilian job opportunities as seen in the media, rather than by actually searching for a civilian job. The performance of the unemployment variable makes it a prime candidate for inclusion in future models.

TABLE 15

ACCURACY OF SINGLE VARIABLE MODEL USING UNEMPLOYMENT IN PREDICTING CAREER RETENTION RATES

Occupational Field	Predicted Retention 1980-4	Predicted Retention 1981-1	Percent Deviation from Actual 1980-4	Percent Deviation from Actual 1981-1	R^2	Level of Significance
General Seamanship	80.3	82.0	6.2	-2.7	.47	.001
Ship's Operations	73.0	74.9	2.4	-10.8	.58	.001
Marine Engineering	58.0	59.8	-6.3	-11.7	.55	.001
Ship's Maintenance	74.4	76.3	4.9	-7.2	.29	.05
Aviation Maint/Weaps	66.3	68.2	2.6	1.0	.55	.001
Aviation Ground Support	73.8	76.1	-3.7	-7.5	.55	.001
Weapons Control	42.2	41.3	-3.5	-5.5	.26	.05
Ordnance Systems	--	--	--	--	.00	NS
Sensor Operations	52.5	53.5	-6.2	-12.9	.08	.01
Data Systems	56.5	58.1	-5.2	-7.6	.17	.10
Construction	79.5	81.4	-4.4	-17.3	.42	.001
Health	72.4	73.0	2.5	-2.7	.11	NS
Administration	78.9	80.1	-2.2	-5.8	.30	.01
Logistics	85.3	87.0	2.8	0.7	.47	.01
Media	76.4	77.0	1.9	-10.0	.02	NS
Cryptology	69.3	68.5	-7.6	-14.3	.17	.10
Communications	73.2	74.2	-3.7	-4.9	.35	.01
Aggregate Ratings	67.2	68.4	-7.7	-7.6	.49	.001

3. Application of Massell's Probability Model

Massell's model results in an improvement in prediction over CRMC. It predicts successfully in more occupational fields than did the unemployment variable but these fields include less of the total force. The model predicts with $\pm$ 5% - the career retention rates for both FY 1980-4 and FY 1981-1 in 5 of 17 fields: General Seamanship, Aviation Ground Support, Administration, Logistics, and Communications. These fields represent 27% of personnel in the FY 1981-1 career force. The prediction for the aggregate is only 2.7% high for FY 1980-4, and 5.4% high for FY 1981-1. The mean error of prediction is 8.6%, essentially the same as the mean error when unemployment is used as the sole explanatory variable. Table 16 shows the results for Massell's model.

Since the model makes use of CRMC as the sole explanatory variable, in a linear regression equation it has the same R^2 and significance as the CRMC-only model. The fact that the predictive value is increased is interesting and bears further analysis.

The reservation wage used by the model may be an accurate reflection of the civilian returns, both pecuniary and non-pecuniary available to enlisted men. In a sense, therefore, this model is similar to a relative wage model although military compensation is the only actual required input. Since the reservation wage concept reflects both pecuniary and non-pecuniary compensation, the model might be an even better forecaster if the military compensation input included both pecuniary and non-pecuniary portions. The difficulty of properly quantifying non-pecuniary aspects of military life may be insurmountable

TABLE 16

ACCURACY OF MASSELL'S MODEL IN PREDICTING CAREER RETENTION RATES

Occupational Field	Predicted Retention 1980-4	Predicted Retention 1981-1	Percent Deviation from Actual 1980-4	Percent Deviation from Actual 1981-1
General Seamanship	78.4	83.6	3.7	-0.8
Ship's Operations	76.4	80.7	7.2	-4.0
Marine Engineering	71.6	76.3	15.6	12.3
Ship's Maintenance	76.8	82.9	8.3	0.9
Aviation Maint/Weaps	74.3	79.6	15.0	17.9
Aviation Ground Support	76.6	82.9	-0.1	0.7
Weapons Control	66.0	61.7	38.4	10.7
Ordnance Systems	76.8	77.4	2.5	-9.6
Sensor Operations	69.9	72.1	24.8	16.1
Data Systems	71.1	76.2	19.1	20.9
Construction	78.5	81.4	-5.6	-16.9
Health	76.4	78.4	8.2	4.5
Administration	78.3	82.2	-2.9	-3.8
Logistics	80.1	86.0	-3.5	-0.4
Media	77.6	79.6	0.9	-7.0
Cryptology	75.7	71.1	0.9	-11.1
Communications	76.6	79.2	0.5	0.5
Aggregate Ratings	74.8	78.0	2.7	5.4

however. An interesting comparison would be the computed reservation wage and the actual civilian compensation of newly released service members. Massell made this comparison for a small scale for the air force electronics repairmen and specialists. She found that the reservation wage was higher than either military or civilian wages. This fact may be reflecting a common perception of both civilian personnel and military personnel that they are somewhat underpaid. A subject of future research may be to expand the study of reservation wage by investigating its magnitude in jobs with low turnover. In that case, of course, one would expect the probability of continuation on the job to be greater than .50.

B. MILITARY/CIVILIAN WAGE RATIO

One method of reflecting the opportunity cost of military service is to construct a relative wage ratio. In addition to the Relative Wage variable discussed in Chapter III, two more wage ratios were constructed. The first used CRMC as the numerator and the Index of All Services Less Rent (SVCS) as the demoninator. The second used CRMC as the numerator and the Average Gross Weekly Earnings Index as the denominator.

The Index of All Services, as discussed in section II.E.2.a. is a price index with the third quarter, Fiscal Year 1980 as the base, equalling 100. The Average Gross Weekly Earnings Index, discussed in II.E.2.b, is also an index with FY 1980-3 equalling 100. This weekly earnings index, however, is constructed from actual dollar earning amounts. These dollar amounts are not adjusted for purchasing power changes as is CRMC. Intuitively, the Relative Wage Variable (RW) discussed in II.E.4 is the

most logical, since both the numerator and denominator are dollar amounts, purchasing power adjusting index.

To determine the best relative wage variable for use in the final model, the intercorrelations among the 3 relative wage variables and the dependent variable were examined. The career retention rate for the aggregate ratings was used as the dependent variable in these correlations. Table 17 displays the resultant matrix.

TABLE 17

CORRELATION COEFFICIENTS FOR RELATIVE WAGE VARIABLES

	$\frac{CRMC}{SVCS}$	$\frac{CRMC}{EARN}$	RW	Aggregate Reenlistment Rate
$\frac{CRMC}{SVCS}$	1.00	.99	.77	.60
$\frac{CRMC}{EARN}$	.99	1.0	.79	.65
RW	.77	.79	1.0	.68
Aggregate Reenlistment Rate	.60	.65	.68	1.0

As can be seen from the Table, the Relative Wage Variable (RW) of military dollars to civilian dollars has the highest correlation with the aggregate reenlistment date, and is therefore used in the final model, with unemployment as the second explanatory variable.

C. RELATIVE WAGES AND 25-39 YR OLD MALE UNEMPLOYMENT

The final model developed in this thesis was relative military compensation and the unemployment rate for males 25-39 years old as the explanatory variable. This model results in occupation field R^2's ranging from .06 to .62. The R^2's greater than .40 occur in fields that employ 63% of the personnel in the FY 1981-1 career enlisted force. The model is significant at the .05 level or higher in 11 occupational fields and for the aggregate careerist reenlistment rate. Table 18 summarizes the model's fit across the occupational fields.

This model exhibits the best fit to past reenlistment rates of the linear regression models used in this study. The fact that three variables are used, even though two are combined in a ratio (relative military compensation) probably accounts for this better fit. As with the models using CRMC and unemployment as single explanatory variables, the operational fields which contain the larger populations show the highest R^2's and significance levels. This may be occurring because in the larger fields an individual decision has less of an effect on the group average, so a smoothing occurs.

Also, the larger occupation fields generally contain more individual ratings in them. An effect on the occupational field's average reenlistment rate by a single rating is much smaller than in the small occupational fields such as cryptology or communications. For example, a change in the sea/shore rotation policy for the radioman rating might greatly affect the Communications occupation field, which contains only Radiomen. A change in the Hull Technician sea/shore policy would

TABLE 18

REENLISTMENT MODEL USING RELATIVE WAGES AND UNEMPLOYMENT

Occupational Field	Level of Significance RW*	Unemp**	Model's Significance	Model's R^2
General Seamanship	.10	.10	.01	.55
Ship's Operations	.25	.025	.01	.60
Marine Engineering	NS	.025	.01	.59
Ship's Maintenance	.05	NS	.025	.44
Aviation Maint/Weps	.25	.05	.01	.61
Aviation Ground Support	.10	.05	.01	.62
Weapons Control	NS	.05	.05	.22
Ordnance Systems	NS	NS	NS	.02
Sensor OPS	NS	NS	NS	.13
Data Systems	NS	NS	.25	.23
Construction	NS	.05	.01	.42
Health	.25	NS	.25	.19
Administration	NS	.25	.05	.33
Logistics	.05	.10	.01	.57
Cryptology	.25	NS	.10	.25
Communications	NS	.25	.025	.37
Aggregate	.25	.10	.01	.56

*RW is defined as weekly CRMC divided by average gross weekly (civilian) earnings.

**Unemployment is defined as 25-39 yr old male unemployment.

affect the Ship's Maintenance occupational field to a much lesser degree, since many other ratings are also in that field.

To use the model to predict reenlistment rates for FY 1980-4 and FY 1981-1 we need the values of military/civilian pay and unemployment for those quarters. The monthly values for real CRMC are $1330 for FY 1980-4 and $1574 for FY 1981-1. The Average Gross Weekly Earnings dollar amounts for FY 1980-4 = $235, FY 1981-1 = $246.

Multiplying the civilian earnings by the purchasing power adjustment index and dividing the result into weekly CRMC the derived RW ratios are 1.44 for FY 1980-4 and 1.67 for FY 1981-1. The unemployment values for the two quarters are 4.7 for FY 1980-4 and 5.0 for FY 1981-1.[8] Table 19 summarizes the results of using the model to predict career retention rates.

The model overpredicts the career retention rate in both quarters in 15 of the 18 cases. In no case does it predict within $\pm$ 5% for both quarters. This result indicates that, according to this model, we would have expected even higher retention rates than actually occurred in 1980-4 and 1981-1. The CRMC for FY 1980-4, which was estimated at $1330, represented a 10.2% increase in real wages from the previous quarter. The FY 1981-1 CRMC, at $1574, represented an increase of 18.3% in real wages over FY 1980-4. Since the effect of VHA and Career Sea Pay were conservatively estimated at $150 for FY 1980-4 and FY 1981-1, it is possible that the increase in real wages was

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[8]Unemployment rates are for males aged 25-39 years old and the source of the rates is Reference 17.

TABLE 19

ACCURACY OF MULTI-VARIABLE MODEL USING R/W AND UNEMPLOYMENT TO PREDICT CAREER RETENTION

Occupational Field	Predicted Retention 1980-4	Predicted Retention 1981-1	Percent Deviation From Actual Retention* 1980-4	Percent Deviation From Actual Retention* 1981-1
General Seamanship	89.9	110	18.9	30.5
Ship's Operations	78.1	91.0	9.5	8.3
Marine Engineering	64.0	78.4	3.3	15.6
Ship's Maintenance	90.4	121	4.6	47.6
Aviation Maint/Weaps	74.2	93.6	14.9	38.7
Aviation Ground Support	83.4	107	8.7	30.0
Weapons Control	41.2	41.2	-13.6	-26.7
Ordnance Systems	75.6	80.7	0.9	-5.8
Sensor Operations	59.7	75.1	6.6	21.9
Data Systems	68.3	98.8	14.6	57.1
Construction	81.7	87.7	-1.8	-10.4
Health	79.2	94.0	12.2	30.7
Administration	84.8	98.0	5.0	14.7
Logistics	95.5	118	15.0	36.6
Media	86.8	109	15.7	27.3
Cryptology	61.8	44.9	-17.6	-44.0
Communications	77.2	86.7	1.3	10.0
Aggregate Ratings	73.2	86.4	0.6	16.7

*Percent deviation from actual retention is calculated as

$$\frac{\text{Predicted - Actual}}{\text{Actual}} \times 100$$

even greater, and the resultant predicted career retention rates would have been even higher.

The model predicted more accurately for FY 1980-4, which is the quarter immediately following the last quarter used to develop the model, than for FY 1981-1, which is two quarters away. The primary source of the error in prediction in FY 1981-1 may be the large October 1980 increase in military compensation, which was quite different from the gradual pay increases of previous years. If the values for military compensation in FY 1980-4 were used to derive new coefficients, it would be expected that the FY 1981-1 predictions would be closer to the actual rates. The model would probably begin to match the increased compensation with the increasing retention rate. Careerists may have been affected by the approaching pay raise earlier than accounted for in the model. Demanding that a model predict across the very significant change in compensation and be within $\pm$ 5% of the actual retention rate may be unrealistic.

It should be noted that while the general trend in the forecasted quarters is for overprediction, the predicted aggregate careerist ratings reenlistment rate for FY 1980-4 is virtually exactly correct. The predicted FY 1981-1 aggregate rate is nearer to the actual rate than the majority of the occupational fields. This results points out that a technique yielding a model that forcasts within reasonable limits for the overall navy ratings may not yield models that predict well when individual occupational field data are used to generate occupational field specific equations.

The equation to predict the aggregate rate would be a better forecaster of individual occupational fields than most of the actual occupational field models. Of the individual field models, only four predicted the FY 1980-4 reenlistment rate within $\pm$ 5% and none were within $\pm$ 5% in FY 1981-1. The four FY 1980-4 forecasting models which were within the error limits represent less than 25% of the FY 1981-1 career force.

These results imply that emphasis needs to be placed on models for the individual occupational fields if occupational specific policies are to be made. It is not difficult to develop a model that can fit past data and predict future retention behavior for the overall Navy ratings. Even attempting to forecast into an "outlier" quarter yielded more accurate predictions from the aggregate rating model than from the individual occupational fields models.

Future iterations of this model would incorporate an updating procedure incorporating FY 1980-4 and FY 1981-1 economic and retention data. Updating to incorporate the new information should increase the predictive accuracy, improving the ability of the model to predict better the effects of any FY 1982 pay increases.

Finally, these results indicate that a linear response function may not be the best functional form for reenlistment behavior. Perhaps a logistic response model incorporating a decreasing returns effect to changes in relative military compensation should be examined. Future research into forecasting reenlistment rates should explore this possibility. No matter which functional form is utilized, attention

should be given to the possibility of time-lagged relationships between the independent variables and reenlistment rates.

D. SUMMARY OF CAREER RETENTION MODELS

Under the assumption of linearity of the relationship between the economic variables and the career retention rate, the following models showed the best forecasting performance for the indicated occupational fields:

1. Occupational Fields Best Forecast by Massell's Model

Field	Regression Coefficient	Regression Constant
General Seamanship	.000784	-.25002
Ship's Maintenance	.000891	-.44900
Aviation Ground Support	.000909	-.48300
Ordnance Systems	.000730	.63400
Administration	.000592	-.00531
Logistics	.000740	-.13900
Media	.000293	.37100
Cryptology	-.000580	1.47000
Communications	.000392	.20500
Aggregate ratings	.000422	.10500

To use Massell's model the mean and STD deviation of the reservation wage is found as follows:

$$\text{STD DEV} = \frac{1}{\text{CRMC coefficient}}$$

$$\text{Mean} = -\text{STD DEV} \times \text{regression constant}$$

The reservation wage and proposed military wage are then normalized and the predicted reenlistment rate is found by:

reenlistment rate = 1 - Prob (Reservation Wage > Military Wage)

A more detailed discussion can be found in Section II.A.3 of this study, and in Reference 5.

To use the monthly CRMC (unemployment) models the proposed CRMC (unemployment) is multiplied by the regression coefficient, and the regression constant is added to that product. The result is the predicted career retention rate.

2. Occupational Fields Best Forecast by Monthly CRMC

Field	Regression Coefficient	Constant
Ship's Operations	.000625	-.11000
Marine Engineering	.000613	-.24400
Sensor Operations	.000271	.16100
Health	.000271	.35900

3. Occupational Fields Best Forecast by 25-39 Yr Old Male Unemployment

Field	Regression Coefficient	Constant
Aviation Maintenance/ Weps	.061100	.37600
Data Systems	.05300	.31600

4. Occupational Fields for Which No Forecast Model Proved Adequate

Weapons Control

Construction

Although the above equations represent the best forecast models found in this study, care should be taken in relying on them too heavily. As was discussed in the Relative Wage and Unemployment model, the relationship between the economic variables and career retention may not be linear. In addition, as of this writing, the reenlistment rates have not "leveled off" so the precise relationship between the change in military compensation due to the October 1980 pay raise and career retention is difficult for any model based on data prior to that large pay raise to forecast.

V. CONCLUSIONS

This thesis has attempted to demonstrate that career enlisted petty officer retention behavior varies considerably over the occupational fields and that previously successful models may not enjoy the same success when used to predict occupational group retention. Models which have good fits to historic data do not necessarily predict future reenlistment behavior with acceptable accuracy.

The development of econometric models for the occupational fields was not attempted in any discovered previous research efforts. This study, therefore, should be considered as an initial investigation into the efficacy of using the occupational field grouping method to manpower policy analysis and forecasting.

The variation of results between the occupational fields indicates that manpower policy should be sensitive to the individual characteristics of the fields. No one model has an universally successful fit or predictive value over the 17 fields and the aggregate. Unemployment, specific to the age group being investigated, was seen to be both the best single variable model for fit to historic data and equal to Massell's probability model in prediction of future retention. However, the fact that Massell's model uses CRMC, a major policy variable, leads to the conclusion that it is the best single variable model.

Some occupational fields were not successfully fit or predicted by any model, or at least by no more than one. The fields of Ordnance Systems, Sensor Operations, Data Systems, Media, and

Cryptology had the poorest fits and forecast results. Of these fields, only Data Systems and Media have easily recognizable civilian counterparts. The lack of a variable to accurately reflect the related civilian opportunities may be the source of the failure in the models which used a military/civilian wage ratio.

It is clear from the results that it is easier to generate an R^2 of greater than .40 than it is to predict within $\pm$ 5% of the actual rate over two quarters. All of the models in this study were developed using historical data from 1976 to 1980. The yearly military pay increases kept at a rather consistant rate over these years. The civilian economic indicators of unemployment and the various wage indices also changed somewhat linearly. Inflation rose at a near linear rate as reflected by the change in the purchasing power index used to deflate CRMC and average weekly earnings. The resultant models, therefore, were fit to a relatively steady change in the independent variables. Starting with FY 1980-4, however, military compensation, and the national economic outlook changed considerably.

The military pay raise of October, 1980 was the largest pay raise relative to the existing pay since the raise of 1971. The starting of Career Sea Pay and Variable Housing Allowance for all personnel, along with the increase in base pay and BAQ, significantly increased regular military compensation. The magnitude of the pay increase and the criteria for receiving Career Sea Pay were well publicized in the fourth quarter FY 1980-4. For the first time pay factors other than base pay and BAQ could be considered a significant portion of the average service member's military compensation. It certainly should

not be considered a mere coincidence that the retention rates for first termers, second termers, and careerists jumped many percentage points during the quarter preceeding the large pay hike. After the raise went into effect the retention rates continued to rise. Any retention equation containing a military compensation component is affected by this abnormally high change in retention rates. To demand that an equation accurately reflect the change may be unrealistic.

FY 1981 has been an "outlier" year for other reasons. The landslide election of a conservative president and the first Republican majority in the Senate in 28 years may have affected service members' decisions about remaining in the military. The trend toward conservatism in the U.S. Government has been well publicized. Even if history will provide that the publicity or perception was greater than the fact, it is reasonable to assume that political, economic, and personal decisions have been made in the past eight months with at least some thought to the future under a government with a conservative executive and senate.

Finally, much publicity has been given to the possibility of a recession, both worldwide and national. Again, whether real or not, the average citizen is confronted by mass media publicity of approaching difficult economic conditions. A career petty officer may opt to remain in the navy with a reasonably secure chance of remaining on active duty until the first opportunity for retirement. The alternative is to leaving the service and becoming unemployed or underemployed in the civilian sector.

For all of the above listed reasons it may have been too demanding to expect a prediction within ± 5% of the actual rate as a criterion for success of a model. If the retention rates continue to rise, or if they level off, or if they fall to below the current levels the models will have to be updated. Fortunately, the data bases used in this study are updated and published each quarter and no esoteric manipulation of data is necessary to update the models.

The fact that the 25-39 year old male unemployment variable was often entered first into the linear regression equations indicated that any future models of retention behavior should consider strongly using a cohort specific unemployment variable. Excluding teenager and elderly unemployment from a model developed for a very different population is conceptually more pleasing than using the national unemployment rate. Future studies might seek to determine whether the average service member nearing a reenlistment point actually seeks outside employment or at least scans the job market prior to making the final decision. If the service member does not, then his perception of civilian employment opportunities is affected by mass media coverage which almost always reports only the national unemployment rates. Bradley's results indicate that the national unemployment rate is a significant variable. If, however, the careerist looks more closely into his particular job opportunities, then the unemployment rate for persons in his/her age group will probably have the greater influence, and this study's results concerning the specificity of the unemployment variable will be reinforced.

This study concludes that the definitive model for retention policy analysis and/or forecasting has not yet been developed. The success of Massell's model when matched against multipredictor models is, with the effect of unemployment discussed above, an area that deserves further investigation.

The goals of this study have been met. Previously successful reenlistment models were subjected to close scrutiny in this thesis. Economic variables such as military compensation, civilian earnings opportunities, and civilian unemployment were tested for their relationship to career reenlistment behavior. Generally, these variables were judged to be statistically significant predictors of reenlistment behavior.

It does appear that a selective military compensation policy, which discriminates between occupational fields, is warranted. The magnitude of this discrimination and any affect, adverse or positive, on the morale and reenlistment behavior should be subjects of continuing research.

APPENDIX A

QUARTERLY REENLISTMENT RATE BY OCCUPATIONAL FIELD

FY-QTR	General Seamanship	Ship Operations	Marine Engineering	Ship Maintenance	Aviation Maint/Weapons	Aviation Ground Support	Air Traffic Control
1976-1	91.70 (289)	74.09 (247)	71.20 (1080)	89.60 (202)	79.48 (1155)	89.52 (105)	83.78 (37)
1976-2	86.56 (309)	81.12 (196)	69.21 (1244)	83.64 (220)	79.47 (1252)	84.62 (143)	84.31 (51)
1976-3	92.08 (303)	91.08 (157)	68.65 (1110)	86.06 (208)	73.04 (1046)	90.00 (143)	74.19 (51)
1976-4	92.64 (299)	83.45 (145)	65.43 (1134)	86.18 (217)	77.77 (1129)	81.15 (122)	68.89 (45)
197T	87.66 (308)	78.77 (146)	54.93 (1176)	80.00 (195)	71.56 (1104)	76.98 (139)	53.33 (45)
1977-1	83.21 (268)	77.12 (153)	58.74 (1018)	85.39 (219)	66.56 (1012)	74.69 (162)	50.00 (42)
1977-2	80.75 (265)	76.67 (150)	59.98 (1172)	71.66 (247)	69.31 (1036)	75.80 (157)	47.50 (40)
1977-3	85.11 (329)	69.89 (176)	63.97 (1088)	74.81 (258)	70.37 (1117)	77.60 (125)	70.97 (62)
1977-4	83.58 (335)	71.43 (168)	57.09 (1284)	64.62 (277)	66.97 (1329)	68.92 (148)	67.16 (67)

FY-QTR	General Seamanship	Ship Operations	Marine Engineering	Ship Maintenance	Aviation Maint/Weapons	Aviation Ground Support	Air Traffic Control
1978-1	78.30 (318)	76.89 (212)	57.67 (1363)	73.38 (263)	68.31 (1281)	76.80 (125)	61.80 (89)
1978-2	72.46 (276)	68.48 (165)	53.42 (1127)	66.21 (219)	58.54 (1124)	68.99 (129)	49.21 (63)
1978-3	78.52 (270)	72.04 (186)	54.74 (1098)	66.95 (236)	61.32 (1197)	68.46 (149)	53.13 (32)
1978-4	71.02 (314)	64.06 (192)	46.60 (1661)	66.90 (287)	57.07 (1400)	72.59 (197)	60.87 (69)
1979-1	78.28 (267)	64.14 (145)	43.74 (1123)	91.49 (141)	55.88 (689)	69.68 (155)	68.42 (57)
1979-2	69.34 (287)	61.27 (173)	51.56 (1123)	67.12 (219)	57.45 (698)	59.28 (167)	40.00 (50)
1979-3	75.68 (296)	70.99 (162)	57.25 (1221)	65.86 (249)	62.96 (1393)	60.77 (181)	73.08 (52)
1979-4	65.63 (320)	60.53 (190)	44.19 (1462)	63.05 (295)	52.26 (1529)	62.86 (175)	64.58 (48)
1980-1	73.45 (290)	65.56 (180)	57.91 (1264)	60.96 (228)	60.31 (1222)	68.06 (144)	67.44 (143)
1980-2	77.16 (359)	75.13 (193)	59.46 (1406)	73.21 (265)	66.69 (1390)	72.99 (174)	76.47 (51)
1980-3	77.34 (274)	71.25 (253)	57.51 (1278)	71.30 (230)	65.04 (1416)	69.93 (153)	70.00 (50)

FY-QTR	General Seamanship	Ship Operations	Marine Engineering	Ship Maintenance	Aviation Maint/Weapons	Aviation Ground Support	Air Traffic Control
1980-4	75.64 (349)	71.30 (216)	61.90 (1531)	70.86 (278)	64.63 (1575)	76.70 (215)	65.71 (35)
1981-1	84.30 (344)	84.08 (333)	67.80 (1916)	82.20 (276)	67.47 (1654)	82.30 (209)	91.43 (70)

FY-QTR	Weapons Control	Ordnance Systems	Sensor Operations	Weapon Sys Support	Master at Arms	Cryptology	Communications
1976-1	38.91 (938)	81.07 (338)	54.20 (238)	76.47 (17)	93.55 (31)	69.64 (280)	85.67 (314)
1976-2	41.87 (996)	79.02 (305)	59.02 (266)	88.46 (26)	84.21 (19)	68.51 (235)	81.65 (376)
1976-3	37.10 (930)	74.34 (304)	55.73 (253)	78.95 (19)	99.99 (21)	67.63 (241)	77.74 (328)
1976-4	39.13 (846)	73.78 (328)	60.45 (220)	82.86 (35)	95.83 (24)	59.68 (253)	79.05 (296)
197T	34.87 (892)	65.82 (275)	31.07 (383)	82.86 (70)	95.00 (20)	55.35 (215)	74.13 (286)
1977-1	36.60 (746)	70.15 (201)	56.44 (202)	82.86 (35)	90.48 (21)	63.77 (207)	76.64 (244)
1977-2	37.28 (751)	69.05 (210)	58.50 (200)	85.71 (35)	90.91 (22)	64.88 (205)	78.42 (241)
1977-3	42.78 (783)	74.74 (293)	50.63 (239)	88.89 (45)	99.99 (15)	75.73 (239)	80.78 (307)
1977-4	38.43 (890)	66.34 (306)	55.47 (265)	75.00 (64)	92.31 (26)	67.92 (240)	69.42 (363)
1978-1	43.45 (824)	72.92 (325)	54.39 (228)	70.37 (54)	99.99 (26)	71.67 (240)	71.02 (421)
1978-2	36.61 (784)	69.69 (254)	51.43 (210)	76.12 (67)	84.62 (26)	60.57 (175)	57.48 (301)

FY-QTR	Weapons Control	Ordnance Systems	Sensor Operations	Weapon Sys Support	Master at Arms	Cryptology	Communications
1978-3	44.14 (648)	74.07 (270)	58.60 (186)	75.00 (60)	94.44 (36)	72.51 (171)	71.74 (276)
1978-4	41.72 (906)	74.11 (309)	48.49 (332)	70.15 (67)	92.31 (26)	76.65 (257)	65.07 (355)
1979-1	46.72 (623)	77.16 (233)	51.87 (187)	59.57 (47)	91.67 (124)	71.51 (172)	71.02 (283)
1979-2	40.96 (625)	70.34 (236)	41.71 (175)	58.14 (43)	94.59 (37)	66.67 (162)	63.69 (314)
1979-3	51.57 (636)	78.29 (281)	51.18 (211)	60.87 (46)	93.94 (33)	71.78 (202)	70.26 (305)
1979-4	37.91 (831)	69.80 (202)	43.87 (424)	66.00 (50)	91.67 (36)	73.71 (232)	64.17 (374)
1980-1	55.54 (659)	72.83 (265)	53.57 (252)	62.50 (32)	81.48 (27)	73.68 (190)	67.42 (353)
1980-2	53.97 (693)	80.69 (290)	57.71 (279)	65.85 (41)	94.44 (54)	81.65 (218)	73.46 (358)
1980-3	45.68 (764)	69.42 (291)	54.02 (261)	64.71 (51)	93.02 (43)	76.42 (212)	78.52 (298)
1980-4	47.70 (942)	74.90 (358)	56.00 (302)	58.33 (48)	93.88 (49)	75.00 (248)	76.19 (315)
1981-1	56.21 (991)	85.68 (405)	61.65 (279)	52.83 (53)	98.15 (54)	80.00 (220)	78.78 (344)

FY-QTR	Administration	Logistics	Media	Musician
1976-1	88.62 (413)	92.64 (964)	85.33 (75)	92.00 (25)
1976-2	89.98 (449)	93.27 (1070)	90.59 (85)	75.56 (45)
1976-3	85.88 (340)	92.00 (933)	71.19 (59)	64.00 (22)
1976-4	84.09 (396)	92.89 (1041)	86.15 (65)	84.21 (19)
197T	77.18 (355)	90.33 (1013)	38.83 (103)	85.71 (21)
1977-1	79.62 (265)	89.72 (963)	80.70 (57)	66.67 (21)
1977-2	84.82 (257)	89.44 (975)	86.21 (58)	75.00 (20)
1977-3	88.06 (3-7)	89.00 (836)	77.89 (95)	86.30 (22)
1977-4	81.74 (356)	86.51 (949)	70.89 (79)	75.76 (33)
1978-1	75.63 (435)	87.47 (958)	80.00 (100)	85.71 (28)
1978-2	65.19 (316)	81.47 (750)	34.00 (100)	66.67 (18)

FY-QTR	Administration	Logistics	Media	Musician
1978-3	85.11 (423)	85.07 (797)	77.59 (58)	80.00 (20)
1978-4	66.22 (447)	81.12 (895)	73.08 (78)	68.18 (22)
1979-1	76.62 (385)	84.85 (693)	70.00 (60)	83.33 (18)
1979-2	69.34 (698)	77.43 (740)	67.03 (91)	82.61 (23)
1979-3	78.20 (500)	62.00 (740)	67.03 (101)	82.61 (29)
1979-4	68.10 (511)	76.76 (895)	78.26 (69)	79.31 (29)
1980-1	76.46 (378)	82.82 (838)	90.57 (53)	77.78 (36)
1980-2	80.16 (489)	86.59 (992)	76.14 (88)	51.43 (35)
1980-3	74.25 (497)	83.13 (889)	78.89 (90)	51.35 (37)
1980-4	80.72 (498)	83.00 (1059)	75.00 (72)	93.75 (32)
1981-1	85.45 (543)	86.40 (1099)	85.56 (90)	86.67 (30)

FY-QTR	Intelligence	Meteor/ Ocean	Aviation Sensor	Data Systems	Construction	Health Care
1976-1	92.86 (14)	52.31 (65)	88.89 (45)	99.99 (51)	86.28 (226)	86.30 (359)
1976-2	55.56 (27)	86.84 (38)	91.30 (46)	61.31 (137)	84.42 (308)	87.00 (377)
1976-3	87.50 (16)	99.99 (19)	90.91 (33)	59.42 (138)	88.05 (226)	68.12 (345)
1976-4	75.00 (12)	94.44 (36)	89.13 (46)	56.67 (120)	94.36 (195)	71.39 (395)
197T	66.67 (6)	72.73 (22)	73.33 (30)	54.96 (131)	94.15 (171)	69.55 (381)
1977-1	76.47 (17)	95.65 (23)	72.00 (25)	50.00 (104)	78.36 (171)	70.93 (313)
1977-2	87.50 (18)	87.50 (24)	73.91 (23)	48.04 (102)	84.05 (163)	68.67 (300)
1977-3	71.43 (31)	90.48 (21)	75.00 (40)	48.57 (140)	78.03 (132)	74.59 (370)
1977-4	65.22 (23)	86.21 (29)	73.47 (49)	49.41 (170)	79.33 (179)	73.26 (430)
1978-1	82.61 (23)	84.38 (32)	78.57 (56)	49.07 (161)	90.40 (125)	75.11 (438)
1978-2	66.67 (18)	65.38 (26)	74.36 (39)	68.67 (83)	70.69 (116)	66.57 (344)

FY-QTR	Intelligence	Meteor/ Ocean	Aviation Sensor	Data Systems	Construction	Health Care
1978-3	71.43 (21)	65.63 (32)	70.21 (47)	53.66 (123)	72.00 (150)	70.33 (428)
1978-4	68.42 (19)	83.33 (24)	68.25 (63)	47.86 (140)	67.05 (173)	66.30 (454)
1979-1	85.00 (20)	64.29 (28)	91.18 (34)	57.28 (103)	58.05 (124)	69.71 (350)
1979-2	71.43 (14)	81.25 (16)	73.53 (34)	47.86 (140)	71.13 (97)	68.81 (436)
1979-3	70.00 (20)	82.05 (39)	75.61 (41)	49.11 (112)	76.13 (189)	70.26 (464)
1979-4	83.33 (24)	76.32 (38)	72.55 (51)	38.46 (169)	71.04 (183)	68.08 (495)
1980-1	94.44 (18)	74.07 (27)	86.79 (53)	57.14 (130)	76.79 (168)	70.67 (375)
1980-2	89.66 (29)	60.00 (30)	81.82 (44)	66.67 (174)	83.84 (229)	74.09 (440)
1980-3	57.89 (19)	75.00 (36)	70.97 (62)	60.66 (122)	82.44 (205)	75.24 (416)
1980-4	80.77 (26)	89.29 (28)	88.24 (51)	59.60 (156)	83.18 (214)	70.63 (463)
1981-1	84.00 (25)	84.38 (32)	91.67 (72)	62.86 (210)	97.88 (236)	75.00 (392)

FY-QTR	Aggregate Ratings	FY-QTR	Aggregate Ratings
1976-1	76.0 (7508)	1978-3	66.5 (6914)
1976-2	75.8 (8268)	1978-4	60.0 (8667)
1976-3	72.4 (7229)	1979-1	62.3 (6115)
1976-4	73.7 (7418)	1979-2	61.2 (6598)
197T	65.6 (7487)	1979-3	64.5 (7634)
1977-1	68.3 (6490)	1979-4	57.3 (8632)
1977-2	68.6 (6671)	1980-1	65.4 (7335)
1977-3	70.9 (7130)	1980-2	70.7 (8321)
1977-4	66.2 (8059)	1980-3	67.3 (7947)
1978-1	68.3 (8125)	1980-4	72.8 (8228)
1978-2	60.9 (6730)	1981-1	74.0 (9541)

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9.	LCDR J. J. Bepko III, USN USS EXCEL (MSO 439) FPO San Francisco, CA 96601	4